MOTOROLA BINARY / TONE ENCODER USER'S MANUAL

EDITED BY THE PAGING DIVISION CONSTRUCTION LAB

First Printing July 1992

Edited from Paging TOP Encoder Manual, Fifth Edition, Second Printing, written by Al Weidler, Motorola Paging Division TOP.

MP MASTER

MA29565

MOTOROLA BINARY/TONE ENCODER USER'S MANUAL

FORWARD

The information in this document has been carefully checked and is believed to be accurate. However, no responsibility is assumed or implied for any inaccuracies. Furthermore, Motorola reserves the right to make changes in function or design of this product or changes in this manual without notice. Motorola does not assume any liability arising from the use of this product or any application thereof; neither does it convey any license under it's patent rights or the rights of others.

The computer programs stored in ROM in this product contain material copyrighted by Motorola, Inc.

EXORCISOR,BPR2000, EXORterm, and Optrx are trademarks of Motorola, Inc.

HP 08640-60501, HP141T, HP1740A, HP334A, HP5335A, HP8552B, HP8554B, HP8656A, HP700/43, and HP9816 are trademarks of Hewlett Parkard Co.,
Inc.

Televideo 910 and 955 are trademarks of Televidio Systems, Inc.

Motorola , Inc.
Paging Division
1500 NW 22nd Ave, Boynton Beach, Fl.

Digitized by the Internet Archive
in 2026

https://archive.org/details/manualsplus_11988

Table of Contents

Chapter	
1	General Information
2	Installation
3	Operating Instructions
4	Functional Description
5	Operational Verification
6	Adjustments
7	Perfromance Tests
8	Maintenace
Appendix	

Chapter 1

Chapter 1

1 General Information

1.1 Introduction

The Motorola Binary/Tone Encoder generates binary and tone code test sequences. It generates Motorola GSC (GOLAY SEQUENTIAL CODE), POCSAG (British POST OFFICE CODE STANDARDISATION ADVISORY GROUP code), Motorola 5/6 Tone, and Motorola 2 Tone sequences in manual and remote modes. It also generates universal and NTT code sequences in remote mode only. These paging code sequences are primarily used for paging binary and tone controlled radios. Also bit steams, square waves, time gaps, code rate, and pseudo random sequences, in remote mode are available for creating universal code test sequences.

The encoder is a solid state test instrument assembled in a portable rack mountable cabinet.

Sections 5 through 9 of this manual can be used as a performance specification and test manual.

1.2 Features

The features of the Motorola Binary/Tone Encoder include:

- Metal cabinet for radiated EMI prevention.
- Front panel keyboard with dome switches for manual menu control.
- Front panel liquid crystal (4 line by 40 character) display.
  Rear panel handles to protect connectors.
- Rear panel AC power switch, fuse, and power connector/filter with removable line cord.
- Rear panel IEEE488 interface with address selection.
- Rear panel RS232C interface with terminal type selection when used with menu firmware (allows menu operation of EXORterm or Televideo 910 terminal on RS232C interface).
- Rear panel outputs for transmission (into 600 ohms), transmission gate (lo power TTL), voice gate (lo power TTL), and audio input.
- Menu driven manual operation.
- Command driven remote communication operation including editor firware on RS232C or IEEE488 interface.
- Generation of random programmable binary and tone sequences.
- Allows mixed code and code rate sequences on single transmission.
- Includes the M68MM17 Monoboard Microcomputer Micromodule as the encoder computer, which contains the M6809 microprocessor.
- Main electronic subassemblies are EXORBUS compatible and plug in for easy maintenance.

1.3 Specifications

Characteristics	Specifications
Microcomputer	M68MM17 Monoboard Micromodule
Manual front panel:	
Keypad	4 row by 8 column dome switches (for alphanumeric, key quadrant, cursor, xmit, stop, and scroll field entries) and 1 switch for reset.
Display	LCD 4 row by 40 character with cursor.
Optional remote front panel (in place of manual front panel):	
Reset switch	momentary switch.
Power indicator	red LED.
Interfaces for remote operation	RS232C and IEEE488.
Inputs:	
AUDIO IN	200 Kohm/AC coupled/2 volts peak.
Outputs:	
TRANSMISSION GATE OUT	lo power TTL. hi level present for duration of transmission, lo level otherwise.
VOICE GATE OUT	lo power TTL. hi level present for duration of voice, lo level otherwise.
TRANSMISSION OUT	1 volt peak signal centered about 0 volts into 600 ohm load with adjustable offset and gain.
IEEE488 addressing	5 rear panel switches with up position, logic 1 and down position, logic 0.
RS232 terminal type selection (used with remote manual operation)	1 rear panel switch, Flag 2 with up position, video terminal ($1E home char) and down position, EXORterm.
Power	90-130 vac, 47-450 hz, 1 amp (may be strapped internally for 180-260 vac operation).
Operating temperature	0-70 degrees C.

Physical characteristics

Width	19 inches.
Height	3.5 inches.
Depth	17.9 inches.
Weight	__ pounds.

Mating connectors

RS232C	25 pin D subminiature male.
IEEE488	IEEE488 standard.
Audio in	BNC male.
Transmission gate out	BNC male.
Voice gate out	BNC male.
Transmission out	BNC male.

1.4 General Description

The Motorola Binary/Tone Encoder is an advanced ATE device capable of generating a variety of test code sequences specifically designed for radio paging. However, its operation is not limited to any specific test cade sequence format however.

The encoder is capable of being operated manually or remotely. Manual operation is done via a keyboard and a display on the front panel and control is done with firmware menus. Remote operation is done via either an RS232C interface or an IEEE488 interface on the rear panel and control is done with firmware commands.

The encoder generates binary and tone code sequences. GSC, POCSAG, .6 Tone, and 2 Tone sequences in manual or remote modes; and NTT and any universal binary and/or tone code sequence in remote mode only.

The encoder can be operated within an EMI tight atmosphere to test RF sensitive radio receivers.

1.4.1 Cabinet

The cabinet of the encoder is metal with a front panel which may contain a dome switch keypad and an LCD 4 line display module. The rear panel contains power, input/output connectors, and address/option switches. Handles are provided on the rear panel for carrying and for connector protection. The encoder may have an optional front panel for remote operation only, this front panel contains only a reset switch and a pilot LED. The cabinet is designed to allow 19 inch standard rack mounting.

The encoder cabinet includes several principle assemblies. These assemblies are the chassis, the front panel, the rear panel, and the card cage.

The cabinet is designed to attenuate EMI radiation and conduction emanating from inside the cabinet to outside the cabinet. Edge slits have been closed with metal-to-metal contact for radiated EMI attenuation, a power filter has been included for conducted EMI attenuation on the power input lines, a low pass filter has been included for EMI conduction attenuation on the transmission output line, the display is covered with a see through metal screen, and the keyboard is covered with a metal foil behind the artwork. Also, star washers are used wherever a conductivity path must exist to cabinet ground. View of the display is inhibited without good illumination.

1.4.2 Front Panel

There are two types of front panels available for the encoder. The first front panel contains a four line by 40 character LCD and a 4 row by 8 column keypad for operator interface with the encoder in manual mode. The second front panel contains only an LED, for power indication, and a switch, for manual reset of the encoder. The second front panel is used for encoder operation in remote mode only.

The first front panel also contains a plexiglas window for LCD protection backed up by a metal screen for EMI radiation attenuation from inside the cabinet. The keyboard also has a foil laminate behind the artwork for EMI radiation attenuation.

1.4.3 Rear Panel

The rear panel contains the AC power connector/filter, a fuse, and a power switch. Also on the rear panel is an RS232C and an IEEE488 interface for communication of the encoder to a terminal or computer in remote mode. The rear panel also has 4 BNC connectors. They are AUDIO IN, TRANSMISSION GATE OUT, VOICE GATE OUT, and TRANSMISSION OUT. The TRANSMISSION OUTput is the binary/tone sequential transmission output to be connected to the modulation input of an RF signal generator. The TRANSMISSION GATE OUTput and the VOICE GATE OUTput signal when the transmission sequence or voice duration, respectively, are present at the TRANSMISSION OUTput. The AUDIO INput allows an external audio signal to be gated through to the TRANSMISSION OUTPUT during the voice duration. Switches for setting the IEEE488 Address and 2 flag switches are present. Flag 2 is used to select a terminal type for the RS232C interface in the manual operating mode. Also, 2 potentiometers for setting the TRANSMISSION OUTput offset and gain are present.

1.4.4 Card Cage

The card cage is designed for subassembly maintainability. It pivots to allow calibration and interchange of the pc boards. The cage holds 4 pc board subassemblies which are arranged according to the cabling which connects the pc boards and for clearance in the cage. The pc board subassemblies (modules) must be arranged as follows from bottom to top:

slot 4 --- CLOCK, INTERFACE, AND OUTPUT MODULE (A4),
slot 3 --- TONE SYNTHESIZER MODULE (A3),
slot 2 --- M68MM17 MICROCOMPUTER MICROMODULE (A1),
slot 1 --- GPIA, DISPLAY, AND KEYBOARD INTERFACE MODULE (A2).

1.4.5 Power Supply

The power supply provides +5 volts at 6 amps, + and - 12 volts at 1 amp to the encoder card cage, front panel, and rear panel circuits. The power supply is a switching supply operated from 115 VAC (or can be jumpered to 230 VAC internally on the power supply).

1.4.6 Power Interconnect

The power connector board allows connection of the AC power to the power supply and connection of the power supply to the rest of the encoder with plug-in cables.

1.5 Equipment Required

The encoder is intended to be interfaced with an RF generator to transmit RF signals to paging receivers, therefore this is the configuration that the following describe:

Manual operation via keyboard control:
- RF Generator (such as HP8656A) with a DC coupled modulation input which operates with a 1 volt peak input voltage. This to be connected to the TRANSMISSION OUTput interface of the encoder.

Manual operation via terminal control and/or monitor:
- RF Generator (such as HP8656A) with a DC coupled modulation input which operates with a 1 volt peak input voltage. This to be connected to the TRANSMISSION OUTput interface of the encoder.
- Video terminal (with $1E home character) or EXORterm. One of these to be connected to the RS232C interface of the encoder.

Remote Operation via RS232C interface:
- RF Generator (such as HP8656A) with a DC coupled modulation input which operate with a 1 volt peak input voltage. This to be connected to the TRANSMISSION OUTput interface of the encoder.
- Standard video terminal or host computer. One of these to be connected to the RS232C interface of the encoder.

Remote Operation via IEE488 interface:
- RF Generator (such as HP8656A) with a DC coupled modulation input which operate with a 1 volt peak input voltage. This to be connected to the TRANSMISSION OUTput interface of the encoder.
- Host computer (such as HP9816). This to be connected on the IEEE 488 interface of the encoder.

Options:
- Instrument to monitor or use transmission gate.
- Instrument to monitor or use voice gate.
- Signal generator or audio source to input audio for voice.

Chapter 2

2 Installation

2.1 Introduction

This chapter provides the unpacking, hardware preparation, and installation procedures for the Motorola Binary/Tone Encoder. This chapter discusses in detail all options available in this encoder.

2.2 Unpacking Instructions

NOTE
If shipping carton is damaged upon receipt, request carrier's agent be present during unpacking and inspection of equipment.

Unpack the encoder from shipping carton. Refer to packing list and verify that all items are present. Save packing material for storing and reshipping the equipment.

2.3 Hardware Preparation

This section decribes the necessary and optional connections and adjustments required for proper operation of the encoder.

2.3.1 External Connections and Adjustments

The following items are the required connections and adjustments necessary to assure a working encoder when first powered up or after repairs have been made:

2.3.1.1 Power Connections

Connect the encoder power to the AC line with the line cord supplied with the encoder. The encoder is shipped with the power supply internally jumpered for 115 VAC operation. If 230 VAC operation is required, the internal power supply must be changed according to the specifications of the power supply in the appendix.

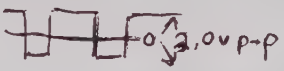
A 1 amp fast blow fuse is shipped with the encoder and is found in the fuse holder on the rear panel. Check this fuse if the encoder does not power-up (note: if power-up does not happen, a pc board or a connector internal to the encoder may be disconnected). Power-up is determined by a legible display on the front panel, for the manual front panel, or a lit red LED, for the remote front panel.

2.3.1.2 TRANSMISSION OUTput Connection

Connect the TRANSMISSION OUTput to an RF generator with a DC coupled modulation input to transmit to a paging receiver. An HP8656A with the DC coupled FM modulation input option or equivalent can be used.

If this output is viewed with an oscilloscope, a 1 volt peak signal centered about 0 volts with square edges or a sinusoid should be present when transmitting, and 0 volts when not transmitting.

Make sure load is 600 ohms.



2.3.1.3 VOICE GATE OUTput Connection

This output can be viewed on an oscilloscope to determine voice duration and position in the transmission. A high logic level signal is present during the voice duration. This output is low power TTL logic.

2.3.1.4 TRANSMISSION GATE OUTput Connection

This output can be viewed on an oscilloscope to determine transmission duration. A high logic level signal is present during the transmission duration. This output is low power TTL logic.

This output can be used to key a transmitter.

2.3.1.5 AUDIO INput Connection

This input can be used as the voice input to the encoder if desired instead of the internal square wave voice (1000 pps) if a switch is changed internally to select it. Reference the functional description of module A4 to locate the switch.

Use an audio signal of 2 volts peak for 1 volt peak encoder output signal.

2.3.1.6 RS232C Interface Connection

This interface can be used to connect an external terminal or a host computer to the encoder. The terminal can be used to monitor and/or control the encoder in the manual or remote modes. The host computer can be used to control the encoder in the remote mode only.

The encoder RS232C interface is shipped internally jumpered for 9600 baud transmission rate and no handshake signals. Also the interface requires 8 bit data, 1 stop bit, and no parity.

Modifications to the baud rate and/or the handshaking signals may be made with internal jumpers to the M68MM17 assembly according to its specifications.

2.3.1.7 IEEE488 Interface Connection

This interface can be used to connect an external host computer to the encoder. The host computer can be used to control the encoder in the remote mode only.

The encoder operates on this interface normally as an interface receiver. The encoder is a transmitter, only when requested to be, with the editor LIST command.

2.3.1.8 TRANSMISSION OUTput Adjustment

The TRANSMISSION OUTput must be measured into a 600 ohm load, measured, and adjusted if necessary. The output should measure 0.0 +/- 0.01 volts quiesent and +1.0 +/- 0.05 volts maximum level to -1.0 +/- 0.05 volts minimum level with a signal. The output OFFSET and GAIN pots on the rear panel of the encoder allow adjustment of the levels. If all the levels cannot be attained with only the rear panel pots, adjustments inside the cabinet must be done. Refer to section 6 for these adjustments.

2.3.1.9 IEEE488 Address Selection

The encoder IEEE488 interface is shipped addressed to 10 (01010 binary). The address can be set with the rear panel switches marked IEEE488 ADDRESS. The switches are activated only on reset of the encoder.

3.1.10 RS232C Terminal Selection

A terminal selection can be made externally with the FLAG2 switch. The FLAG2 switch in the up position enables use of a video terminal with a "HOME" character = 1A (hex) for proper manual mode operation. A Televideo 910 has been used to test this feature. The FLAG2 switch in the down position enables use of the EXORterm for proper manual mode operation. Remote operation is independent of either terminal selection by the switch, and any standard video terminal which interfaces to the RS232C can be used. The FLAG2 switch is activated only on reset of the encoder.

2.3.2 Internal Connections and Adjustments

The following items are the required internal connections and adjustments necessary to assure a working encoder when first powered up or after repairs have been made:

2.3.2.1 AUDIO INput Selection

The AUDIO INput is selected by a switch on the A4 module in the card cage. This input allows external audio to gated as the encoder voice signal during the voice transmission duration. See sections 4.2.4 and 5.10.1 for details.

2.3.2.2 Board Address Selection Requirements

Modules A2 and A4 have 3 quad address switches on each. These switches st be set for the correct EXORBUS address in order for the encoder firmware to operate correctly. Set the switches to the correct addresses as detailed in sections 4.2.2 and 4.2.4.

2.3.2.3 Encoder Output Board Adjustments

Module A4 is the encoder output before being buffered by module A6. Two pots on A4 set the output offset and gain for the binary code signals. Details of this are in section 6.3 and 6.4.

2.3.2.4 Tone Synthesizer Adjustments

Module A3 is the tone synthesizer. Three pots on A3 set the tone level and offset before being applied to module A4. Details of these adjustments are in sections 6.3 and 6.5.

Chapter 3

3 Operating Instructions

3.1 Introduction

All the displays, controls, and connectors used by the operator are located on the front and rear panels of the encoder. This section describes their functions as the encoder is used either in the manual mode, remote manual mode, or remote auto mode.

3.2 Controls and Display

The encoder's controls and display are located on the front panel. The controls consist of the keyboard keys. The display is the LCD.

The reset key allows the user to reset the encoder; this performs reset the same as a power-up.

The 16 keys to the left of the keyboard are the alphanumeric keys; these are used exclusively for entering data into the numeric and alpha-numeric fields of the encoder menu during manual operation of the encoder. The numeric and alphanumeric fields of the menu are always enclosed in parentheses.

The keyboard cannot be used during remote operation.

The 4 keys in the top right of middle of the keyboard labelled KEY QUAD are the key quadrant select keys; they allow selection of each of the 4 quadrants of the alphanumeric keys only. One of these keys is required to be pressed only before a quadrant change in any key press sequence. The quadrant defaults to the upper left upon reset of the encoder.

The 4 keys below the KEY QUAD keys labelled CURSOR are the cursor control keys; they allow the user to move the cursor underline of the display from field to field or among field characters within a numeric or alphanumeric field. These keys allow up, down, left, and right movements of the cursor if a movement is valid, otherwise no movement of the cursor will occur for that key.

The keys labelled ENTER and XMIT perform identical functions to the encoder. One of these keys is pressed if the title page of the manual encoder menu appears on the display and the user desires to select the code displayed in the scroll field, or if a transmission of a selected menu is desired.

The key labelled STOP is pressed (or any other key except RESET for that matter) to abort a transmission in progress.

The key labelled SCROLL [FIELD] is pressed if an item scroll is desired in a scroll field of the encoder menu. This key is used only in a menu field enclosed in brackets [].

3.3 Manual Mode Operation

The Motorola Binary/Tone Encoder is used in the manual mode mainly ·ough the front panel display and keyboard. Manual mode can also be used through the RS232C interface connected to an external terminal. The manual mode is exercised through the use of a menu.

The menu allows manual operation of the encoder. The menu is operated with the cursor keys on the keyboard to move the cursor underscore from field to field on the display. There are two general types of fields, the scroll field and the entry field. The scroll field can be scrolled with the space key to each of its selections. The entry field allows entries to be keyed in individually as numerics or alphanumerics. Entries are keyed in by first keying the key quadrant desired, then the key. In many cases the menu for a code type contains more than one page. The next, or previous, page may be entered by the cursor down, or up, key when the last field the cursor existed in was the bottom, or top, field of the page. The one exception to this is the code selection (reset) menu page which is exited with the ENTER or XMIT keys. The two general field types are designated in the menu by brackets [] for scroll fields, and by parentheses () for entry fields. The SCROLL [FIELD] key is the same as the space bar and the ENTER or XMIT keys are the same as the return key of an external terminal. Invalid entries make no field changes and a beep is heard.

In the manual menu mode two terminal types may be used. An EXORterm can be connected when the FLAG2 rear panel switch is "down" and a video terminal with $1E home char (Televideo 910) can be connected when the FLAG2 rear panel switch is "up" upon RESET or power-up of the encoder.

All transmissions are invoked by pressing the XMIT or ENTER key of the front panel keyboard or the return key of a terminal.

Any transmission may be aborted by pressing any key while the transmission is in progress.

3.3.1 Code Type Menu

The code type menu of the encoder allows the operator to select the pe of code or calibration sequence desired. The selection is made with ne SCROLL [FIELD] key. After the selection is made, the ENTER or XMIT key must be pressed to either enter the code type menu if a code type was selected, or transmit a calibration sequence if a calibration selection was made. This menu will reappear after a calibration sequence was transmitted but not after a code type was entered. The RESET key must then be pressed to return to this menu. Selection of remote mode is also done here but cannot be operated or displayed through the front panel.

3.3.2 Calibration Selection

Calibration can be done on the encoder TRANSMISSION OUTput with either the BINARY CALIBRATION or the TONE CALIBRATION selections. The output offset and gain can be adjusted through the rear panel adjustment potentiometers. The BINARY CALIBRATION selection outputs a binary sequence of 1-0 pattern at 125 hz square wave for 4 minutes. The TONE CALIBRATION selection outputs a sine frequency of 1 Khz for 30 seconds. Output calibration levels are + and - 1 volt DC for the maximum and minimum levels, and 0 volts for no transmission. The TONE CALIBRATION tone of 1 Khz has a worst case distortion specification of 3%.

3.3.3 Code Type Selection

A new menu is displayed when a CODE type is selected. GSC, POCSAG, 6 Tone, and 2 Tone codes are selectable.

3.3.3.1 GSC Code Menu

The TRANSMIT FUNCTION line of the first page of the GSC menu allows selection by scroll of a function, all 4 functions, 300 hz comma, or GSC preambles to be transmitted. Functions 1 thru 4 and ALL 4 select the address which gets transmitted in the queue selected in the queue field. Comma is a 300 hz square wave queue for 50 seconds duration. Preamble is a GSC preamble queue consisting of 5 blocks of 50 preamble words per block each block preceded with 56 bits of comma. The preamble queue facilitates radio tuning by inhibiting the battery saver from turning on in the radio.

The QUEUE field of the first page of the GSC menu allows selection by scroll of the GSC queue type. The GSC queue types are SINGLE CALL, BATCH, EXTENDED BATCH, and ECHO. The SINGLE CALL queue type consists of preamble, sync, address, and message blocks in sequence with no breaks in the sequence. The BATCH queue type consists of inverted preamble, sync, 15 address blocks of comma (300 pps square wave), address, and message blocks in sequence. The EXTENDED BATCH queue type consists of inverted preamble, sync, 16 blocks of comma, sync, 15 blocks of comma, address, and message blocks in sequence. Finally, the ECHO queue type consists of 75 hz square wave for 1.25 seconds followed by address and message blocks in sequence.

The ADDRESS line of the first GSC menu page contains a field for scroll selection of the IGGAAA or the PABCDEF cap code address format. The second field allows address code selection (including an N for the first character of the IGGAAA type if preamble 0 is desired) by entry selection. (Note: ABEF character position of the PABCDEF address format have a range of 0000 to 4094. If a 4 entry is attempted on character position A with BEF greater than 094 the entry will not be accepted. BEF must first be set less than 096. Also character positions D and F must be even entries).

The second page is selected by down cursor.

The FUNCTION/MESSAGE type line of the second page of the GSC menu allows a function/message match to be selected. For each function scrolled on the function field there is a message which can be selected on the message field. Message types are TONE-ONLY, VOICE, NUMERIC, ALPHANUMERIC, and ENHANCED NUMERIC. TONE-ONLY is really no message, VOICE gates an audio input from the AUDIO INput bnc connector on the rear panel or an internal 1 khz wave during the voice duration of the queue, NUMERIC is a numeric only message (ie., BPR 2000), ALPHANUMERIC is an alphanumeric message (ie., OPTRX), and ENHANCED NUMERIC is an expanded numeric plus alpha character set message (ie., OPTRX numeric). The voice input is selected with an switch on the CLOCK, INTERFACE, AND OUTPUT MODULE (A4).

The OUTPUT POLARITY field of the second page of the GSC menu allows normal or inverted polarity of the TRANSMISSION OUTput by scroll.

The address/data ERROR line of the second page of the GSC menu allows address or data error types and severity to be selected by scroll in two fields. This feature allows decreased paging sensitivity and beep on bad data in the pager to be tested.

The third page of the GSC menu is selected with a down cursor key.

The MESSAGE TYPE field allows the various message types to be selected by scroll. Message field contents are displayed on the next line of the page. Voice messages contain an entry field for duration entries up to 54 seconds. Numeric messages contain an entry field allowing only numeric character set entries of up to 24 characters. Alphanumeric messages contain an entry field allowing all alphanumeric characters of up to 32 characters. Finally, the enhanced messages contain an entry field allowing the expanded numeric character set of up to 11 characters entry. This

field changes dynamically by disallowing a character for each expanded set character (non-numeric) entered; thus up to 6 expanded set chars can be entered or a mixture of numeric and non-numeric of from 6 to 11 chars can be entered. (Note: it is advised that the enhanced numeric field not be edited with left and right cursor keys, if editing is required use the up cursor then the down cursor and re-enter all the characters desired. The enhanced numeric message field entry algorithm is not perfected yet).

The first page of the GSC menu can be reselected with a down cursor key.

3.3.3.2 POCSAG Code Menu

The FUNCTION line of the first page of the POCSAG code menu allows lection of a POCSAG function, ALL 4 functions, or PREAMble by scroll.

The ADDRESS line of the first page of the POCSAG menu allows POCSAG address selection by numeric entry of any address up to 2097151.

The ERROR line of the first page of the POCSAG menu allows address or data errors of 0,1,3,5, or 9 errors for each by scroll.

The second page of the POCSAG menu is selected by down cursor key.

The OUTPUT POLARITY line of the second page of the POCSAG menu allows normal or inverted output polarity to be selected by scroll.

The MESSAGE line of the second page of the POCSAG menu allows numeric or alphanumeric messages to be selected by scroll.

The bottom line of the second page of the POCSAG menu allows the numeric or alphanumeric message to be changed with character entries. The NUMERIC data field allows 20 characters of which 0 thru 9,U,[,], ,- are valid. The ALPHANUMERIC data field allows 37 characters of the entire ASCII set to be entered.

The first page of the POCSAG menu can be reselected with a down cursor key.

3.3.3.3 2 Tone Code Menu

The TONE SEQUENCE line of the 2 TONE code menu allows tone-A/tone-B tone-B/tone-A sequences to be selected by scroll.

The TONE A FREQUENCY line allows the frequency of tone-A to be entered with numeric characters and a decimal point. Entries of 10.00 thru 9999. are allowed.

The TONE B FREQUENCY line allows the frequency of tone-B to be entered with numeric characters and a decimal point. Entries of 10.00 thru 9999. are allowed.

The second page of the 2 TONE menu is selected with the down cursor key.

The FUNCTION line of the second page of the 2 TONE code menu allows the transmission queue type of the 2 TONE paging codes to be selected by scroll. TONE-ONLY, TONE-AND-VOICE, TONE-ONLY BATTERY SAVER, TONE-ONLY GROUP CALL, TONE-AND-VOICE GROUP CALL, SUBAUDIBLE TONE-AND-VOICE, and SUBAUDIBLE TONE-ONLY selections are included.

The VOICE DURATION line of the second page of the 2 TONE code menu allows the voice duration of the voice to be entered by numeric characters. Entries up to 65 seconds are valid.

The first page of the 2 TONE menu can be reselected with a down cursor key.

3.3.3.4 5/6 Tone Code Menu

The FUNCTION field of the first line of the 5/6 TONE code menu ows function 1,2, or Preamble of the 5/6 TONE address to be selected by scroll. The Preamble selection transmits 50 preamble tones of 690 ms followed by 45 ms of gap each.

The ADDRESS field of the first line of the 5/6 TONE code menu allows addresses to be entered by numeric characters. Two identical characters in positions 4 thru 6 of the address field will generate an internal "R" character in the second of the two characters entered. The "R" 's will appear in the field after a transmission has occured. An "N" character may be entered into the first position of this field to inhibit the transmission of any preamble tone.

The MESSAGE TYPE line of the 5/6 TONE code menu allows selection of the type of message to follow the address in a transmission. TONE-ONLY and VOICE are the possible selections by scroll.

The VOICE DURATION line of the 5/6 TONE code menu allows the duration of the voice to be entered by numeric characters. Entries of up to 65 seconds are valid.

The first page of the 5/6 TONE menu can be reselected with a down cursor key.

3.4 Remote Communication Operation

The Motorola Binary/Tone Encoder can be used more universally through remote interfaces on the rear panel.

3.4.1 Remote Manual Mode Operation

The Motorola Binary/Tone Encoder is used in the remote manual mode only through the RS232C interface with an external terminal. The remote manual mode is exercised through the use of an editor. Any terminal which can operate through an RS232C interface may be used.

The editor allows the remote manual mode operation of the encoder. The editor issues a "." prompt character to the operator who then types commands with arguments to control the encoder. The editor allows the operator to build queues with queue blocks. The queue blocks are numbered from 0 to 89. They can be accessed randomly.

3.4.1.1 Editor Commands

The following commands control the encoder through the editor; all command lines must be terminated with a carriage return character without a linefeed character for proper entry:

3.4.1.1.1 Duplicate

Duplicate queue block(s) "a" thru "b" to queue block starting at "c".

Syntax: Da(a),b(b),c(c)

D is the duplicate command.
a is the first source queue block (1 or 2 digits).
, is a delimiter.
b is the last source queue block (1 or 2 digits).
c is the first destination queue block (1 or 2 digits).
Queue block "c" must be outside of "a" to "b" range. "a", "b", and "c" must be less than 90 each.

3.4.1.1.2 Insert

Insert argument into queue block "a".

Syntax: a(a),[argument]

is the queue block (1 or 2 digits) which specifies insert command.
, is a delimiter.
argument is 1 queue block entry as specified in section 3.4.1.2.
Queue block "a" must be less than 90.

3.4.1.1.3 Kill

Kill queue block(s) "a" thru "b". This command fills specified queue block(s) with 16 null characters per block.

Syntax: Ka(a)(,b(b))

K is the kill command.
a is the first queue block (1 or 2 digits).
, is a delimiter.
b is the last queue block (1 or 2 digits).
Queue blocks "a" and "b" must be less than 90 and "b" must be greater or equal to "a".
Nulled queue blocks are skipped over in transmission; no gap in the transmission occurs.

3.4.1.1.4 List

'ist queue block(s) "a" thru "b".

Syntax: L(a(a)(,b(b)))

L is the list command.
a is the first queue block (1 or 2 digits).
, is a delimiter.
b is the last queue block (1 or 2 digits).
Queue blocks "a" and "b" must be less than 90 and "b" must be greater or equal to "a".

The list command allows viewing of the queue blocks set up in the queue buffer.

3.4.1.1.5 Evoke Menu

Evoke menu. Exit editor and enter menu.

Syntax: M

This command enables manual mode operation.

3.3.1.1.6 Transmit

Transmit queue block(s) "a" thru "b" for "c" repetitions.

Syntax: X(a(a)((,b(b))(,c(c))))

X is the transmit command.
a is the first queue block (1 or 2 digits).
, is a delimiter.
b is the last queue block (1 or 2 digits).
c is the number of queue repetitions (1 or 2 digits).
Queue blocks "a" and "b" must be less than 90 and "b" must be greater or equal to "a". "c" must be less than 90 also.

This command invokes the encoder to transmit the queue buffer contents in increasing order of the labeled queue blocks. Invalid arguments are ignored without transmission gaps in the sequence, or if severe enough, the transmission is aborted.
Any transmission may be deliberately aborted by receiving a character other than ctl-I or ctl-N on the RS232C during the process of transmission. A ctl-I will invert the transmission on the next bit after the ctl-I is entered. A ctl-N will normalize the transmission on the next bit after the ctl-N is entered.

Notes:
1. a, b, and c are digits.
2. () are optional entries.
3. [] are required entries.
4. , is a delimiter
"arguments" are characters specified in queue block entries of item 3.4.1.2.

3.4.1.2 Queue Block Entries

The following items are arguments of queue blocks of the editor insert mand:

3.4.1.2.1 General Blocks

Transmission bit rate must be selected by using any of the rate blocks before the timing of a transmission can be determined. Also, make certain when using a rate block that it is preceded by enough transmission bits from another block preceding it in the queue. Once a bit rate is selected, it need not be used again in the queue unless a change in bit rate is desired in the queue. Also, when retransmitting any queue, the last bit rate selected will be in force. The default rate is 1200 bps (GSC).

The following blocks are generic and can be selected for all codes of the encoder:

3.4.1.2.1.1 Hexidecimal Bit Sequence

Hexidecimal bit sequence queue block.

Syntax: H[bb]$[(aaaaaaaaaaaa)]

H is the hexidecimal bit sequence queue block designator.
bb is the number of bits to be used in the bit sequence. Each hexi-
decimal character contains 4 bits, the MSB is transmitted first
of the first character. Range is 01 bit to 48 bits.
is a delimiter signifying hexidecimal characters to follow.
« » are the hexidecimal characters 0 thru 9 and A thru F.
The total number of characters which must be entered is
int ((bb-.25)/4 +1), any more will be ignored.

This queue block allows a universal bit sequence to be generated using hexidecimal characters to describe each 4 bit pattern in the sequence. Up to 48 bits can be described. This block is useful for creating any binary code set the user desires. Bits are transmitted from left to right.

3.4.1.2.1.2 Pseudo-Random Sequence

Pseudo-random sequence queue block.

Syntax: R[aaaaa]

R is the pseudo-random sequence queue block designator.
a's are the duration of the pseudo-random sequence queue block in trans-
mission bits in the queue. The a's cannot be greater than 65535.

This block generates a pseudo-random sequence of bits which is seeded only the first time it is called in a transmission.

3.4.1.2.1.3 Queue Recursion

eue recursion; re-queue blocks "aa" thru "bb" for "cc" repetitions within ne normal queue.

Syntax: B[aa],[bb],[cc]

B is the queue recursion queue block designator.
aa is the beginning queue block (2 digits).
bb is the ending queue block (2 digits).
cc is the number of recursion repetitions (2 digits).
Queue blocks "aa" and "bb" must be less than 90 and "bb" must be greater or equal to "aa"; "cc" must be less than 90. The B queue block can be used recursively within other B queue blocks. Caution: since this queue block sets up queue recursion, the operator must be careful not to specify blocks "aa" thru "bb" to call itself; otherwise an infinite recursive depth will be realized and the encoder program will eventually either get lost or be aborted with an "s" error (stack/queue buffer interception).

This block enables queues outside or within a queue to be called into the queue. This block allows queues of extremely long duration to be set up. Be careful not to get too many B blocks calling other B blocks, since this will result in the computer stack overwriting queue blocks decreasing from 89 on down in the queue buffer. The user can view the stack overwrite by listing the queue buffer with the editor command L. Nonsense characters appear at the end of the queue buffer from blocks 89 and lower depending on how many B block recursions have been executed. Make certain that the stack does not overwrite entered blocks. Blocks not used will not cause trouble.

3.4.1.2.1.4 General Code Rate

General code rate queue block. This block sets up a timer to interrupt encoding processing to output a transmission bit of the total transmission queue. It must precede a general queue and must be preceded by a block of about 100 bits of transmission so to not cause a transmission underflow error.

Syntax: @C[a][bbbbb][c]

@ is the code rate queue block designator.
C is the general code designator.
a is the transmission output polarity which will exist after this queue block is encoded (N or I).
b's are the encoder timer 3 latches entry which sets the transmission bit rate. The transmission bit rate = clock rate / ((bbbbb + 1) * 8). The b's must not be greater than 65535.
c is the timer 3 clock input selection; I = internal clock (1 Mhz), X = external clock (614.4 Khz).
The code state is not changed; i.e. GSC, POCSAG, TONE, etc. are code states. This queue block requires 1 transmission bit period to encode in the queue.
This queue block allows the user to change the bit rate of the transmission any place in the queue. It does not change the code state, however. To change the code state, the code rate of the particular code is required be selected first, then this block can be selected afterwards. This block requires 1 bit in the transmission to encode, the last transmitted bit will remain in its last state when this block transmits.

3.4.1.2.1.5 Space (Gap)

Space or gap queue block.

Syntax: O[aaaaa]

O is the space or gap queue block designator.
a's are digits which cannot be greater than 65535. They specify the duration of the space or gap queue block in transmission bits.

This queue block outputs a ground voltage level on the transmission output for the duration of the block. This block is useful for gaps of time between tones or binary sequences or to break up queues. It is most frequently used to precede the "@" queue block at the beginning of a transmission.

3.4.1.2.1.6 Square Wave

Square wave queue block.

Syntax: .W[aaaaa][b][c]

W is the square wave queue block designator.
a's are the queue block duration which cannot be greater than 65535. They specify the square wave queue block duration in transmission bits.
b is the starting square wave logic level (H or L).
c is the number of transmission bits between square wave transitions (which sets the frequency) and cannot be greater than 9.

This queue block generates square waves for the duration of the block. This block is useful for batch type queue fill-in sequences.

3.4.1.2.1.7 Voice

Voice queue block.

Syntax: V[aaaaa]

V is the voice queue block designator.
a's are digits which cannot be greater than 65535. They specify the duration of the voice queue block in transmission bits.

This block gates the audio input from either the external audio input or the internal timer set for 1khz square wave selectable by SW1 on A4. Also the voice gate output is at a logic "1" level during the voice duration.
This queue block should be placed between 2 activation code queue blocks when used with GSC voice queues.

3.4.1.2.2 GSC Blocks

The GSC queue blocks will operate correctly if they are preceded by the C code rate block @G which sets up the GSC code bit rate for 1200 bps and sets the GSC code state to enable only GSC code blocks and general code blocks into the queue.

The following blocks are allowed in the GSC code of the encoder in addition to the general blocks:

3.4.1.2.2.1 GSC Activation Code

GSC activation code queue block.

Syntax: C(E(b(b)))

C is the activation code queue block designator.
E is error designator.
b's are error severity digits of GSC word 1 and 2 respectively, ranges are 0 thru 3 for error severities of 0, 1, 5, and 14 respectively.

This queue block contains 56 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC activation code word 1, followed by 2 bits of comma, followed by GSC activation code word 2 (inverted from word 1). Each GSC activation code word contains 92 bits (BCH [23,12] code words at 4 transmission bits per code word bit).

This block is only useful before and after the GSC voice block to evoke the page alert and squelch the voice of a GSC radio pager.

3.4.1.2.2.2 GSC Address

GSC address queue block.

Syntax: A[aaaaaaa](E(b(b)))

A is the address queue block designator.
aaaaaa are address digits inserted as ABCDEF cap code of ECHO GSC.
E is error designator.
b's are error severity digits of GSC word 1 and 2 respectively, ranges are 0 thru 3 for error severities of 0, 1, 5, and 14 respectively.

This queue block contains 56 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC address CD code word 1, followed by 2 bits of comma, followed by GSC address ABEF code word 2. Each GSC address code word contains 92 bits (BCH [23,12] code words at 4 transmission bits per code word bit).

This block is required to encode a GSC address (function) into a queue.

3.4.1.2.2.3 GSC Alphanumeric Data

GSC alphanumeric data queue block.

Syntax: T[aaaaaaaaa](C)(E(b))

T is alphanumeric data queue block designator.
a's are alphanumeric data characters.
(a null can be specified with a control-@ character if desired for invisible end of message spacing).
C is the continue message designator; required if another alphanumeric queue block follows this block. If C is not used and errors are used, a space character must be inserted between the 8th alpha character and "E".
E is error designator.
b is the error severity of the data block, its range is from 0 thru 3 for error severities of 0,1,2, and 4 errors per (15,7) code word within the data block respectively.
Note: if less than 8 characters are entered after the data block is built, nulls must be inserted if continue or errors are to be included, since character position is required to encode the continue and errors into the data block.

This queue block contains 2 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC alphanumeric data block containing 8 - 6 bit data characters and their parity arranged as 8 BCH [15,7] code words interleaved by degree 8. See the appendix for a detailed figure of this data block.

This queue block can handle up to 8 alphanumeric characters. If less than 8 characters are used, the rest of the block must contain nulls (for end of message if errors are used) or spaces (if continue is used) to fill the block and position the C and E characters for continue and errors in the correct character positions in the block.

This queue block is required to encode GSC alphanumeric messages into the queue. To make messages longer than 8 characters in a queue, use the continue in each data block and add another data block.

3.4.1.2.2.4 GSC Enhanced Numeric Data

^C enhanced numeric data queue block; used for OPTRX numeric messages.

Syntax: E(aaaaaaaaaaaa)(C)(E(b))

First E is enhanced numeric data queue block designator.
a's are enhanced numeric data characters as follows:
0,1,2,3,4,5,6,7,8,9,(null),U,(space),-,=,A,B,C,D,E,F,G,H,J,L,N,P,R
(a null is specified with a control-@ character).
C is the continue message designator.
Second E is error designator.
b is the error severity digit of the data block, its range is from 0 thru 3 for error severities of 0,1,2, and 4 errors per (15,7) code word within the data block respectively.
Any enhanced numeric character greater than "=" require 2 locations of the 12 locations allowed for the data message, the operator must keep this in mind when building a data block.
Note: if less than 12 characters are entered after the data block is built, nulls must be inserted if continue or errors are to be included, since character position is required to encode the continue and errors into the data block.

This queue block contains 2 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC enhanced numeric data block containing 12 - 4 bit data characters and their parity arranged as 8 BCH [15,7] code words interleaved by degree 8. See the appendix for a detailed figure of this data block.

This queue block can handle up to 12 enhanced numeric characters. If less than 12 characters are used, the rest of the block must contain nulls (for end of message if errors are used) or spaces (if continue is used) to fill the block and position the C and E characters for continue and errors in the correct character positions in the block.

This queue block is required to encode GSC enhanced numeric messages into the queue. To make messages longer than 12 characters in a queue, use the continue in each data block and add another data block.

3.4.1.2.2.5 GSC Numeric Data

GSC numeric data queue block; for all numeric data pagers.

Syntax: N(aaaaaaaaaaaaa)(C)(E(b))

N is numeric data queue block designator.
a's are numeric data characters as follows:
0,1,2,3,4,5,6,7,8,9,(null),U,(space),-,=,E
(a null is specified with a control-@ character).
C is the continue message designator.
E is error designator.
b is the error severity of the data block, its range is from 0 thru 3 for error severities of 0,1,2, and 4 errors per (15,7) code word within the data block respectively.
Note: if less than 12 characters are entered after the data block is built, nulls must be inserted if continue or errors are to be included, since character position is required to encode the continue and errors into the data block.

This queue block contains 2 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC numeric data block containing 12 - 4 bit data characters and their parity arranged as 8 BCH [15,7] code words interleaved by degree 8. See the appendix for a detailed figure of this data block.

This queue block can handle up to 12 numeric characters. If less than 12 characters are used, the rest of the block must contain nulls (for end of message if errors are used) or spaces (if continue is used) to fill the block and position the C and E characters for continue and errors in the correct character positions in the block.

This queue block is required to encode GSC numeric messages into the queue. To make messages longer than 12 characters in a queue, use the continue in each data block and add another data block.

3.4.1.2.2.6 GSC Preamble

GSC preamble queue block.

Syntax: P[a][b][cc](E(d))

P is the GSC preamble queue block designator.
a is the preamble word designator (0,...,9 allowed).
b is the polarity of the preamble word (N or I); I is for batch mode.
cc is the number of preamble words in the queue block (18 for GSC).
E is the error designator.
d is the error severity of the preamble words in the queue block;
d can range from 0 thru 3 for 0,1,5, and 14 errors per preamble word respectively.

This queue block contains 56 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC preamble code words each consisting of 92 bits (BCH [23,12] code words at 4 transmission bits per code word bit).

This block is required to encode a GSC preamble into a queue. The standard GSC preamble contains 18 preamble words in the block.

3.4.1.2.2.7 GSC Code Rate

GSC code bit rate queue block.

Syntax: @G[a]

@ is the code rate queue block designator.
G is the GSC code designator.
a is the transmission output polarity which will exist after this queue block is encoded (N or I).
The encoder timer 3 latches entry which sets the transmission bit rate for GSC = 00063. The transmission bit rate = clock rate / ((bbbbb + 1) * 8) = 1200.
The timer 3 clock input selection = X for external clock of 614.4.Khz.
The GSC code state is set.
This syntax is almost equivalent to @C[a]00063X except that GSC code state is also set.

This queue block requires 1 transmission bit to encode in the queue. This block must precede a GSC queue and must be preceded by a block containing about 100 bits of transmission to not cause a transmission underflow error. This block sets the GSC code bit rate to 1200 bps and sets the code state for GSC so that other codes are disabled and GSC codes are enabled in a queue.

4.1.2.2.8 GSC Sync

GSC sync queue block.

Syntax: S(E(a(a)))

S is the sync queue block designator.
E is error designator.
a's are error severity digits of address word 1 and 2 respectively, ranges are 0 thru 3 for error severities of 0, 1, 5, and 14 respectively.

This queue block contains 56 bits of comma (300 pps square wave at a bit rate of 1200 bps), followed by GSC sync code word 1, followed by 2 bits of comma, followed by GSC sync code word 2 (inverted from sync word 1). Each sync code word contains 92 bits (BCH [23,12] code words at 4 transmission bits per code word bit).
This block is required to encode a GSC sync into a queue.

3.4.1.2.3.4 POCSAG Numeric Data

POCSAG numeric data queue block.

Syntax: N(aaaaa)(E(b))

N is the numeric data queue block designator.
aaaaa is the 5 numeric data character field.
Valid chars: 0,1,2,3,4,5,6,7,8,9,U, ,-,],[.
E is the error designator.
b is the error severity digit. Range is 0 thru 4 for 0,1,3,5, or 9 errors.

This queue block contains a POCSAG numeric BCH [31,16] +1 bit parity code word for a total of 32 bits. The numeric data message consists of 5 characters. If a message less than 5 characters is used, the rest of the character positions must be filled in with nulls (for end of message bits if continue character is not used) or spaces (if error characters are used). If errors are used without the continue, a space or null must replace the continue character.

This block is required to encode a POCSAG numeric data block into a queue.

3.4.1.2.3.5 POCSAG Code Rate

POCSAG code bit rate queue block.

Syntax: @P[a]

@ is the code rate queue block designator.
P is the POCSAG code designator.
a is the transmission output polarity which will exist after this queue block is encoded (N or I).
The encoder timer 3 latches entry which sets the transmission bit rate for POCSAG = 00149. The transmission bit rate = clock rate / ((bbbbb + 1) * 8) = 512.
The timer 3 clock input selection = X for external clock of 614.4.Khz.
The POCSAG code state is set.
This syntax is almost equivalent to @C[a]00149X except that POCSAG code state is also set.

This queue block requires 1 transmission bit to encode in the queue. This queue block must precede a POCSAG queue and must be preceded by a block of about 100 bits of transmission as to not cause a transmission underflow error. This block sets the POCSAG bit rate to 512 bps and the code state to POCSAG to enable only the POCSAG queue blocks and the general queue blocks except voice into the queue.

3.4.1.2.3.6 POCSAG Sync

POCSAG sync queue block.

Syntax: S(E(a))

S is the sync queue block designator.
E is the error designator.
a is the error severity digit. Range is 0 thru 4 for 0,1,3,5 or 9 errors.

This queue block contains a POCSAG sync BCH [31,16] +1 bit parity code word for a total of 32 bits.
This block is required in encode a POCSAG sync block into a queue.

3.4.1.2.4 Tone Blocks

The tone queue blocks will operate correctly if they are preceded by a tone code rate block @T which sets the tone code bit rate to 1000 bps (1 ms duration increments) and sets the tone code state to enable only tone code blocks and general code blocks into the queue.

The following blocks are allowed in the TONE codes of the encoder in addition to the general blocks:

3.4.1.2.4.1 5/6 Tone Address

5/6 Tone address queue block.

Syntax: A[aaaaaa](X)

A is the address queue block designator.
aaaaa is the 5 Tone cap code digits. Range is 00000 thru 99999 and R.
X is the optional 6th tone X for function 2.

This queue block is required to encode a 5/6 Tone address into a queue. This block consists of 5 tones of 33 ms duration each followed by either a 6th tone or a gap of 52 ms. The total duration of the block is 165 ms if the code bit rate is 1000 bps.

Note: An "R" character must be inserted as the second of 2 tone digits if a duplicate tone digit is to be used in two consecutive digits of the cap code for valid 5/6 tone addresses.

3.4.1.2.4.2 5/6 Tone Preamble

5/6 Tone preamble tone queue block.

Syntax: P[a]

P is the preamble queue block designator.
a is the preamble tone digit. Range is 0 thru 9.

This queue block is required to encode 5/6 tone preamble into a queue. This block consists of a selected preamble tone of 690 ms duration followed by a 45 ms gap.

.4.1.2.4.3 Tone Frequency and Duration

requency and duration queue block.

Syntax: F[aaaaa]R[b]D[ccccc]

is the frequency queue block designator.
aaaa is the 4 significant frequency digits. Range is 0001 thru 9999.
is the frequency range digit. Range and meaning are as follows:
0 -- frequency = aaaa hz --- filter cutoff = 21500 hz;
normally used for frequencies between 1000. and 9999. hz.
1 -- frequency = aaaa/2 hz --- filter cutoff = 12000 hz;
can be used for frequencies between 500.0 and 4999.5 hz for lower distortion than 0 range by using same "aaaa" entries as 0 range or for frequencies requiring a .5 hz fractional frequency with 5 digit precision.
2 -- frequency = aaaa/10 hz --- filter cutoff = 1770 hz;
normally used for frequencies between 100.0 and 999.9 hz.
3 -- frequency = aaaa/100 hz --- filter cutoff = 167 hz;
normally used for frequencies between 10.00 and 99.99 hz.
is the queue block duration designator.
ccccc is the queue block duration digits. Range is 00001 thru 65535 transmission bits.

This queue block is required to set up a filtered frequency (sinusoid) for discrete tone type applications in the queue. This block consists of selected frequency for a selected duration of transmission bits determined by the code bit rate. The cutoff filter and the frequency range are dependent, therefore care must be taken to insure proper frequency and filter operation. For best results, never use a 0 in the most significant digit when specifying the frequency, then choose the correct divisor to set the range; this will insure the best filter response for a frequency of lowest distortion.

.4.1.2.4.4 Tone Code Rate

Tone code bit rate queue block.

Syntax: @T

is the code rate queue block designator.
is the Tone code designator.
The encoder timer 3 latches entry which sets the transmission bit rate for Tone = 00124. The transmission bit rate = clock rate / ((bbbbb + 1) * 8) = 1000.
The timer 3 clock input selection is set for the internal clock of 1 Mhz.
The Tone code state is set.
This syntax is almost equivalent to @C[a]00124I except that Tone code state is also set.
This queue block requires 1 transmission bit to encode in the queue. This queue block must precede a tone queue and must be preceded by a block of about 100 bits of transmission as to not cause a transmission underflow error. A tone queue normally is transmitted at a bit rate of 1000 bits/sec 1 ms timing intervals. This queue block sets the timing intervals to ms (1000 bps) and sets the code state for tone to enable tone blocks in the queue.

3.4.1.2.5 NTT Blocks

The NTT queue blocks will operate correctly if they are preceded by the code rate block @N which sets the NTT code bit rate to 200 bps and sets the NTT code state to enable only NTT code blocks and general code blocks into the queue.

The following blocks are allowed in the NTT codes of the encoder in addition to the general blocks:

3.4.1.2.5.1 NTT Address

NTT address queue block.

Syntax: A[aaaa](E(b))

A is the address queue block designator.
aaaa is the 4 hexidecimal cap code digits. Range is 0000 thru FFFF.
E is the optional error designater.
b is the optional error severity digit of range 0 thru 3 for 0,1,2,or 3 errors respectively.

This block consists of a BCH (31,16) code word.
This queue block is required to encode an NTT address into a queue.
When using the GPIB interface, in remote auto mode only (described in section 3.4.2), this block generates an SRQ just prior to being transmitted. The SRQ lasts about 2 seconds unless serial polled by the GPIB controller. The serial poll status is hexidecimal 4A or octal 112.

3.4.1.2.5.2 NTT Bit and Frame Sync

NTT bit and frame sync queue block.

Syntax: S[a](E(b))

S is the bit and frame sync queue block designator.
a is the bit length of sync selector, range is "N" (normal), "-" (1 less bit or "+" (1 more bit).
E is the optional error designater.
b is the optional error severity digit of range 0 thru 2 for 0,1,or 2 errors respectively.

This block consists of 9 bits of square wave followed by 14, 15, or 16 bits of sync depending on whether -, N, or + is selected in the "a" field.
This queue block is required to encode an NTT bit and frame sync into a queue.

.4.1.2.5.3 NTT Group Sync

T group sync queue block.

Syntax: G[aa](E(b))

is the group sync queue block designator.
a is the group number selector, range is 01 thru 15.
is the optional error designater.
is the optional error severity digit of range 0 thru 2 for 0,1,or 2
errors respectively.

This block consists of a BCH (7,4) code word.
This queue block is required to encode an NTT group sync into a queue.

.4.1.2.5.4 NTT Code Rate

NTT code bit rate queue block.

Syntax: @N[a]

is the code rate queue block designator.
is the NTT code designator.
is "N" or "I" to normalize or invert the entire transmission.
he encoder timer 3 latches entry which sets the transmission bit rate for
Tone = 00383. The transmission bit rate = clock rate / ((bbbbb + 1) * 8)
= 200.
timer 3 clock input selection is set for the external clock of 614.4Khz.
ne NTT code state is set.
his syntax is almost equivalent to @C[a]00383X except that NTT code
state is also set.

This queue block requires 1 transmission bit to encode in the queue.
his queue block must precede an NTT queue and must be preceded by a block
f about 100 bits of transmission as to not cause a transmission underflow
rror. An NTT queue normally should be transmitted at a bit rate of 200
ps for proper operation. This queue block sets the NTT code bit rate and
ets the code state for NTT to enable NTT blocks and general blocks into
he queue.

3.4.1.3 Transmission Messages

The encoder displays transmission messages to the RS232C to indicate ious transmission conditions. There are 5 transmission messages reported to the operator either during or at the end of the transmission. If a message appears during a transmission the rest of the transmission is aborted. The message consists of the queue block where the transmission stopped followed by a ":" then the message type character. If the transmission completed, the queue block will be "90" or the next block to be transmitted if either the transmission aborted or the "X" command had a limited queue block range specified (less than 89 for "b"). The message type character can be either of the following:

- a indicates an intentional abort of the transmission; any char except ctl-N or ctl-I received.
- e indicates a syntax error or invalid char-set error was specified in a queue block.
- f indicates the transmission completed properly.
- s indicates a 8 queue block or a series of 8 queue blocks were specified which caused the stack to intercept the queue block buffer at the block reported.
- u indicates a transmission underflow of encoded sequence occured. This means that the transmission sequence being sent to the encoder output happened too fast for the encoding routine to set up new transmission patterns. This error will occur if queue blocks which are too short are specified too close together in the queue or they are specified at the beginning of the queue.

The IEEE488 interface receives none of this information.

The NTT address outputs an SRQ interrupt to the IEEE488 interface before each address appears in the transmission. This is useful since the NTT code requires synchronous transmission for very long durations.

.4.2 Remote Auto Mode

The encoder remote auto mode operates exactly like the encoder remote ual mode except that the remote auto mode is used with a host computer onnected to either the RS232C or the IEEE-488 interface. Also, with use on he IEEE488 interface, the transmission message of section 3.4.1.3 are not utput on the interface at any time; the SRQ of the interface is used to eedback transmission status of the end of transmission, NTT addresses, and ransmission errors.

Transmissions on the IEEE-488 interface override any menu or editor perations. The first character received on the IEEE-488 interface (prefer- bly a carriage return character) invokes the IEEE-488 override condition nd causes all communication with the encoder to be limited to the IEEE- 88 bus. Manual menu mode can be reinvoked with an "M" followed by a carriage eturn.

Each command line sent to either interface must be terminated with carriage return character only, no linefeed.

All responses by the encoder RS232C interface terminate with carriage eturn, linefeed, and "." prompt. The end of transmission also includes message string.

The only characters which can be sent by the encoder on the IEEE-488 nterface are those sent by the list command. Each line sent by the list ommand is terminated with carriage return and linefeed characters.

For the IEEE-488 interface, the SRQ and serial poll status is issued or certain transmission activity. An NTT address, about to transmit, will ssue an SRQ and status of hexidecimal 4A or octal 112. End of transmission ith no errors will issue an SRQ and a status of hexidecimal C0 or octal 00. Transmission error or abort will issue an SRQ with a status of hexi- imal 60 or octal 140. These SRQ's will last about 2 seconds then be uto reset unless the GPIB controller serial polls the GPIB which causes he SRQ to be reset immediately.

Also, for the IEEE-488 interface, a control-I character will invert he total transmission at the transmission output within 1 bit interval fter the character is received. Similarly a control-N character will ormalize an inverted transmission.

Chapter 4

4 Functional Description

4.1 Introduction

The Motorola Binary/Tone Encoder is made up of modular assemblies. This section generally describes the functions of each the the encoder's modular assemblies.

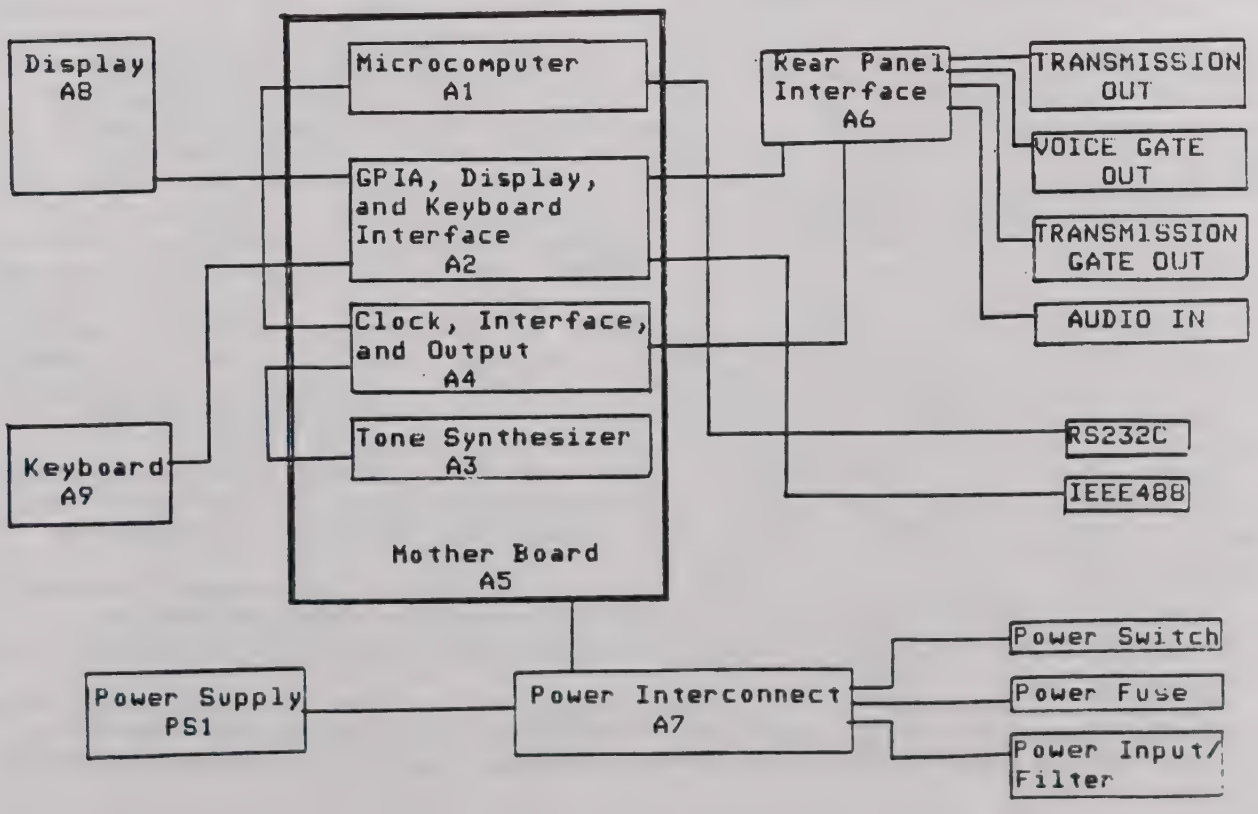
4.2 Modules

The encoder is made up of 4 principle mechanical assemblies and 10 principle electronic assemblies. The mechanical assemblies are the CABINET, the FRONT PANEL, the REAR PANEL, and the CARD CAGE. The electronic assemblies are subassemblies of the mechanical assemblies. The FRONT PANEL contains the KEYBOARD (A9) and the DISPLAY (A8). The REAR PANEL contains the REAR PANEL MODULE (A6). The CARD CAGE contains the MOTHERBOARD (A5); the CLOCK, INTERFACE, AND OUTPUT MODULE (A4); the TONE SYNTHESIZER MODULE (A3); the GPIA, DISPLAY, AND KEYBOARD INTERFACE MODULE (A2); and the MICROCOMPUTER MODULE (A1). The CABINET contains the POWER INTERCONNECT MODULE (A7) and the POWER SUPPLY (PS1).

These 10 principle electronic modular assemblies plus surrounding assemblies are shown in the subsystem block diagram of Figure 4-1.

The subsystem interconnect diagram is shown in figure 10-9.

Figure 4-1
Encoder Subsystem Block Diagram



The electronic modular assemblies are described generally in the following:

4.2.1 MICROCOMPUTER MODULE (A1)

This module is the heart of the encoder. It contains the microcomputer and all the necessary interfaces for operation into the EXORBUS, the RS232C, and the CLOCK, INTERFACE, AND OUTPUT MODULE clock circuits. The microprocessor is the M6809. This module contains an M6840 ACIA for the RS232C interface, an M6840 PTM for timing thru the IRQ, and is programmed to accommodate a 2K byte RAM (TMS4016) and four 4K byte EPROMS (MCM2532's) for present and future encoder firmware. For complete specifications on this module, refer to the M68MM17/D2 manual.

The functional configuration of this module is shown in figure 4-2.

The mechanical configuration of this module is shown in figure 10-1. Three 4K byte EPROMS and one 2K byte RAM are presently required for this module in the encoder application. The PROM (U16) is programmed to address the on-board sockets (XU30, XU22, XU36, and XU48) for 16K bytes of EPROM and socket (XU17) for 2K bytes of RAM.

The encoder EPROMs ENCD-1, ENCD-2, and ENCD-3 must be plugged into sockets XU22, XU36, and XU48 respectively with two socket terminals exposed nearest pin 1 of each socket. Jumpers at J25 must be located to program for a TMS4016 RAM. Jumpers at J27 and J31 must be located to program for MCM2532 EPROMs. U16 must contain an 82S123 PROM programmed for a 16K ROM space. Jumpers J13 and J15 should be programmed such that the RS232C port acts like a modem with the CTS line tied high for no interface handshaking.

..2.2 GPIA, DISPLAY, AND KEYBOARD INTERFACE MODULE (A2)

This module controls the IEEE488 interface, the display, and the keyboard. It contains an address decoder to set and decode its address from the EXORBUS, sockets for four 4K byte EPROMS (MCM2532's) for encoder menu firmware, two PIA's for interfacing to the display, keyboard, and IEEE488 address switches and flag switches, a GPIA and drivers for the IEEE488 interface, and the data drivers to the EXORBUS.

The functional configuration of this module is shown in Figure 4-3.

The mechanical configuration of this module is shown in Figure 10-2. The 4 EPROM sockets must contain the menu EPROMS. The menu EPROMS labelled MENU-1, and U3 respectively.

The address switches SW1, SW2, and SW3 must be set to address $2020. SW1-2 and SW3-2 switches must be ON and all 10 other switches OFF for this address. Jumper J1 must be connected to enable the EPROMS. Disconnecting J1 allows the module to be plugged into the EXORCISER for troubleshooting as this disables the on board EPROMS so that EXORCISER memory can be used.

PIA1 controls the LCD cursor address, the IEEE488 address switches and the 2 flag switches on the rear panel, the keyboard columns, and the LCD character position. PIA2 controls the LCD control lines, the LCD character and the keyboard rows.

The GPIA is addressed to $2020 thru $2027, PIA1 is addressed to $2028 thru $202B, and PIA2 is addressed to $2030 thru $2033. The EPROMS are addressed as follows: U6 is at address $4000, U5 at $5000, U4 at $6000, and U3 at $7000.

To test this module in the EXORCISER, break J1, set the address switches to address $E020 by setting SW1-3 and SW1-2 ON also. The GPIA is now at addresses $E020 thru $E027, PIA1 is at addresses $E028 thru $E02B, and PIA2

is at addresses $E030 thru $E033. The EPROMS are then at addresses as follows if J1 would be connected: U6 at address $8000, U5 at $9000, U4 at $A000, and U3 at $B000.

The schematic diagram of this module, figure 10-10, shows 2 sheets for A2. The first sheet contains the address decoder on the left, the 4 EPROMS on the upper right, and the data drivers to the EXORBUS on the lower right. Sheet 2 shows the GPIA and its 2 drivers for the IEEE488 interface on the top, the 2 PIAs in the middle left, 2 LCD address buffers on the lower left, and the IEEE488 address switches and 2 flags switches buffer on the lower middle.

The PIA1 A side registers are multiplexed among 3 operations; LCD cursor address outputs, IEEE488 address and flag switch inputs, and keyboard column inputs and outputs. The PIA1 B side registers are LCD character position addresses. The PIA2 A side registers 0 thru 3 are LCD control outputs and registers 4 thru 7 are keyboard row inputs and outputs. The PIA B side registers are LCD character outputs.

4.2.3 TONE SYNTHESIZER MODULE (A3)

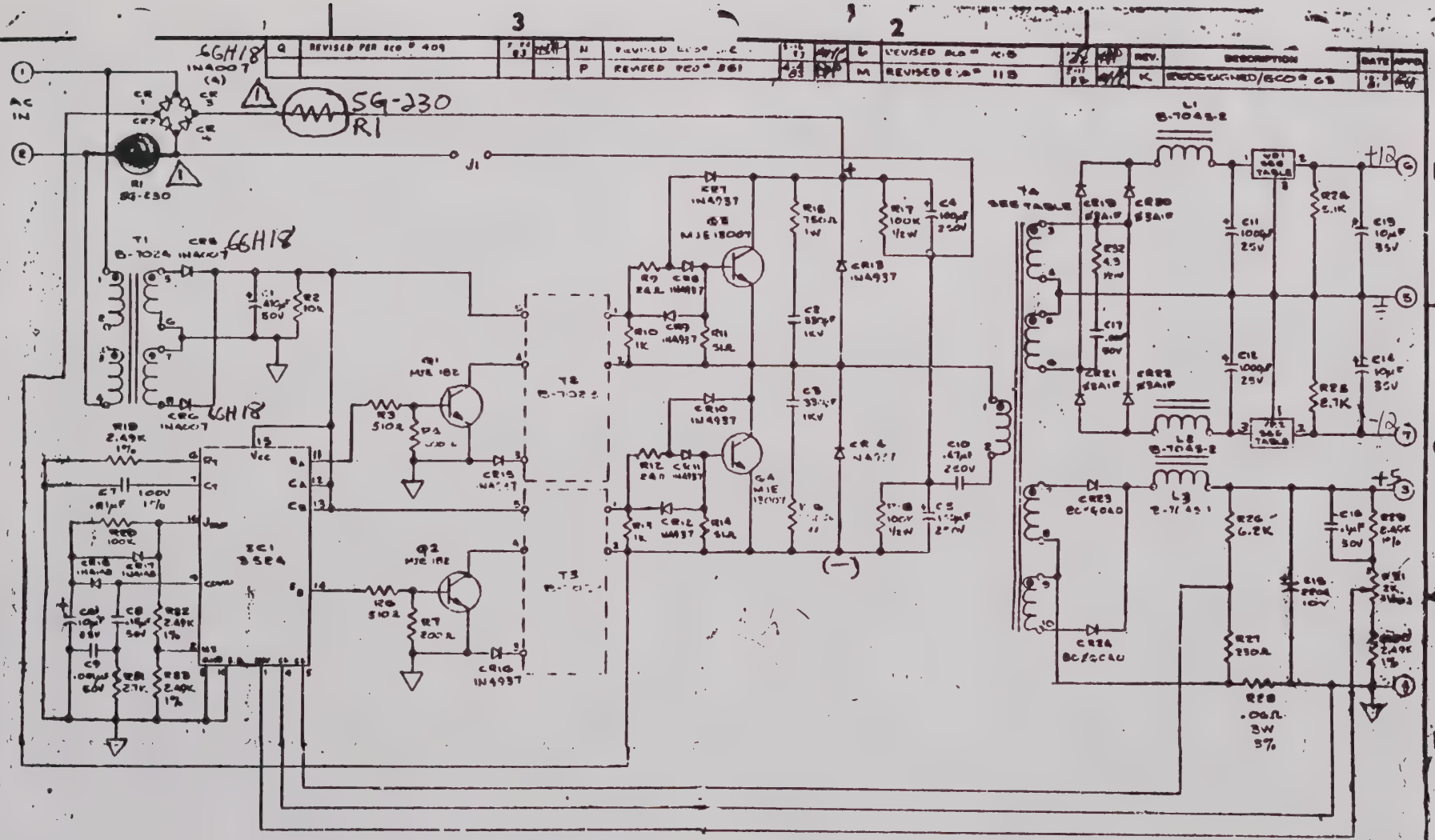
This module generates the sinusoidal tones necessary for all tone codes. It contains a frequency data latch to hold the MS 2 digits of the frequency data from the A4 module, 4 bcd rate multipliers to generate the digital pulse repetition rate for frequency generation from the 4 digit frequency data, pulse rate divider stages with 4 range selection, a sinusoidal amplitude programmed PROM, an 8 bit binary DAC, a 3 pole 4 range active Butterworth filter, and an output amplifier with offset and gain adjustment.

The functional configuration of this module is shown in Figure 4-4.

The mechanical configuration of this module is shown in Figure 10-3. U8 must contain an 82S123 PROM programmed for sinusoid amplitude data for a single cycle of 32 data points as shown on the bottom left of the schematic diagram A3 in Figure 5-10 /0-11

This module has no EXORBUS addressing, it operate from an interface to module A4 which sends the frequency data as 2 bytes of 2 bcd digits in each byte in sequence. The MS byte is strobed into latch U13 and the LS byte is held on the interface data lines for the duration of frequency generation.

U14, U15, U12, and U11 are the bcd rate multipliers which generate anywhere from 0 to 9999 pulses at the output of U16 depending on the 4 digit frequency data present on the inputs from U13 and the P2 data interface. A 0 generates no pulses, a 9999 generates 9999 pulses for every 10000 clocks. The clock input comes from a 2.56 Mhz clock from the P2 interface. U17 and U5 are digital dividers which divide the pulse rate from U16 by 8, 16, 80, and 800. U6 allows selection of the pulse rate from 2 lines from the P2 interface which control the range and filter selection. U7 divides the rate by 32 to address the U8 PROM for the sinusoid amplitude data to be presented to the DAC at U9 in sequence 0 thru 31. The output of the DAC should be adjusted for a sinusoid output of from 0 to 10 volts swing. R21 is the pot and TP3 is the test point. The signal should look like a sinusoid with steps. U2, U3, and U4 make up the 4 range selection and active parts of the 3 pole Butterworth filter. The 4 range frequency breakpoints are at 21.5Khz, 12KHz, 1.77Khz, and 167hz. Each range is selected from firmware between a frequency near 1/2 that of the breakpoint at the high end to a frequency about 1/20 of the breakpoint at the low end. Distortion is greatest at the low end since the frequency is farthest away from the breakpoint of each filter. The worst case distortion should be less than 3%; the best, about 0.5%. The output of U4 pin 7 should be a filtered sinusoid signal of the frequency selected by the 4 bcd digits. The output offset and gain can be adjusted by



⚠ SOME REVS HAVE R1 THERMISTR IN ONE OR THE OTHER CONFIG.

JAN 21 1983

CONFIDENTIAL

NEXT ASSY	USED ON
APPLICATION	

POWER GENERAL

SCHEMATIC SERIES 805C

SIZE C | CODE IDENT NO | DWG. NO. 7126

SCALE | SHEET

upply voltages, bypass capacitors for bus power, an optional DC fan power
onnector, a DC power connector, a connector and resistor for an LED which
contained on the optional auto encoder front panel, and a connector and
istor for a reset switch contained on the optional auto encoder front
anel.

The mechanical configuration of this module is shown in Figure 10-5.
his module mounts on the bottom of the CARD CAGE module.

The schematic diagram of this module is shown in Figure 10-12.

.2.6 REAR PANEL MODULE (A6)

This module controls the encoder TRANSMISSION OUTPUT offset and gain,
asses the TRANSMISSION GATE OUT, the VOICE GATE OUT, and the AUDIO IN port
ignals between A4 and the rear panel BNC connectors, and contains the
EEE488 address switches and 2 flag switches for the A2 interface.

The offset and gain are adjusted by 2 pots located on the module which
re accessible through the rear panel of the encoder cabinet.

The mechanical configuration of this module is shown in Figure 10-6.

The schematic diagram of this module is shown in Figure 10-13.

To test this module, connect it to A4 to test the output amplifier
nd connect it to A2 to test the switches.

.2.7 POWER INTERCONNECT MODULE (A7)

This module routes the AC power signals from the rear panel line power
nput/filter and fuse holder to the power switch and the power supply and
o routes the power supply DC output power to the CARD CAGE module.

This module contains a jumper to connect cabinet ground to AC ground.

The mechanical configuration of this module is shown in Figure 10-7.

The schematic diagram of this module is shown in Figure 10-14.

.2.8 LIQUID CRYSTAL DISPLAY MODULE (A8)

This module is the display for the encoder. It contains a 4 line by
0 character LCD display plus cursor. Specifications for this module are in
he appendix.

.2.9 KEYBOARD MODULE (A9)

This module is the encoder keyboard. It contains a 4 row by 8 column key
atrix in which the 4th row, 8th column key is not in the matrix; this key is
separate 2 line key switch.

The mechanical configuration of this module is shown in Figure 10-8. The
6 keys to the left of the keyboard are for alphanumeric characters where
ach key represents 1 of 4 quadrants controlled by the encoder firmware. The
upper left center keys are assigned key quadrant control by the encoder
irmware. The 4 lower left center keys are assigned cursor control by the
ncoder firmware. The 7th column upper 2 keys are assigned ENTER and XMIT and
he 8th column upper 2 keys are assigned STOP and SCROLL [FIELD]. The 8th
olumn lowest key is the RESET key which controls a hardware reset to the
oder.

The schematic diagram of this module is shown in Figure 10-15.

4.2.10 POWER SUPPLY MODULE (PS1)

This module is the encoder power supply. It delivers +5 volts/6 amps, + and - 12 volts/1 amp to the encoder.

Specification of this module is found in the appendix.

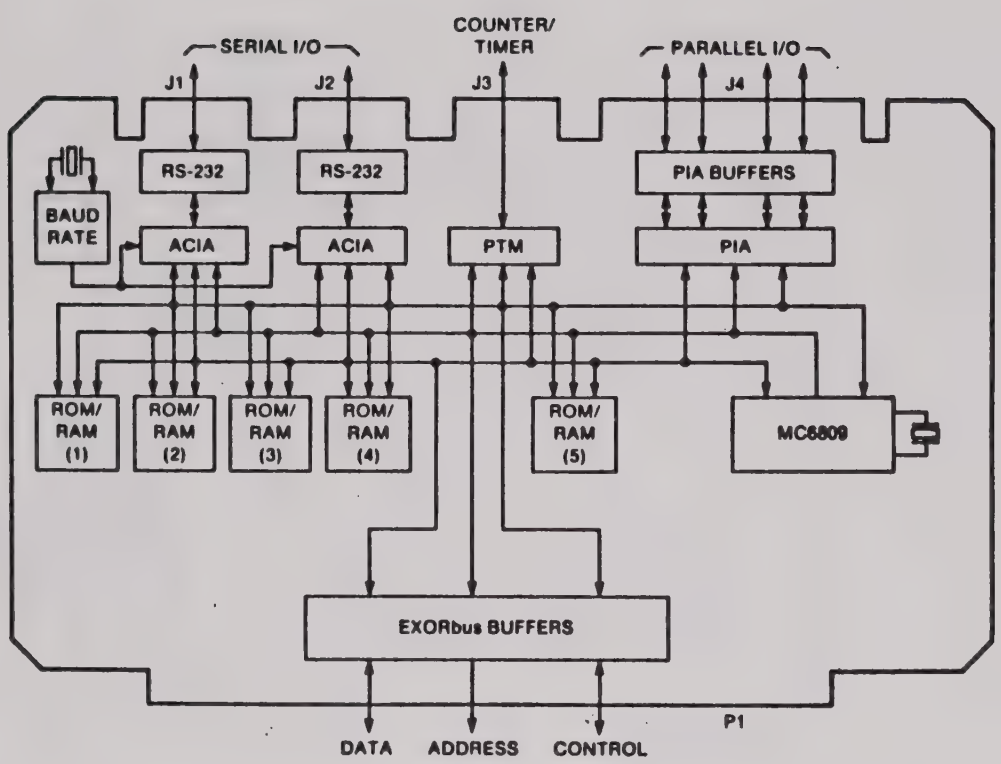


FIGURE 4-2 Micromodule 17 Block Diagram

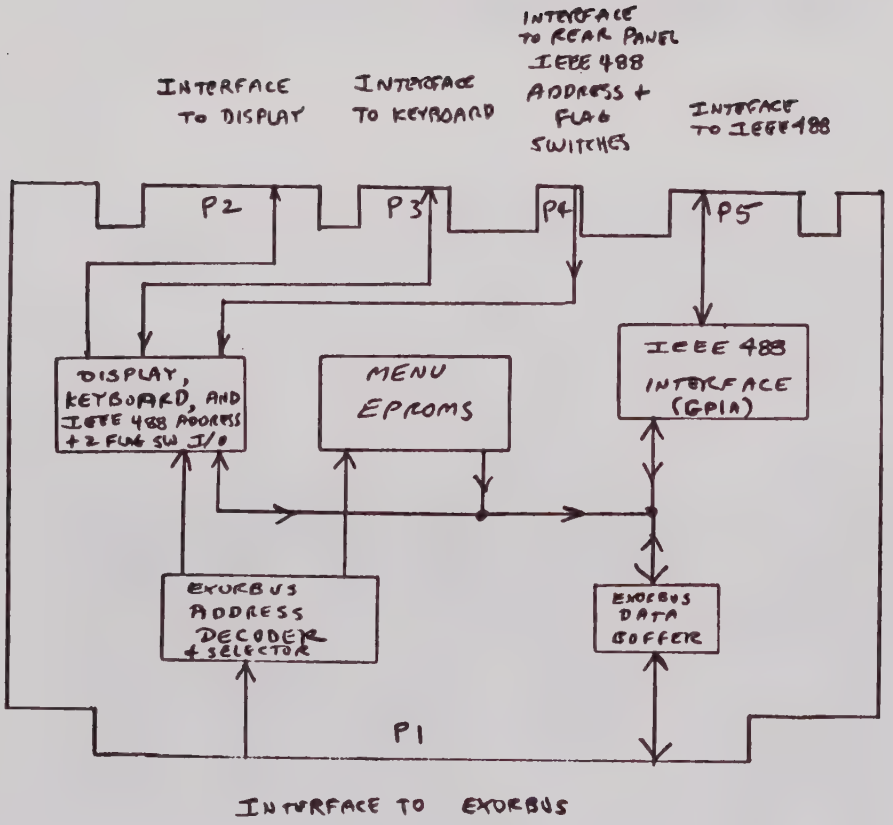


FIGURE 4-3 GPIA, DISPLAY, AND KEYBOARD MODULE (A2)

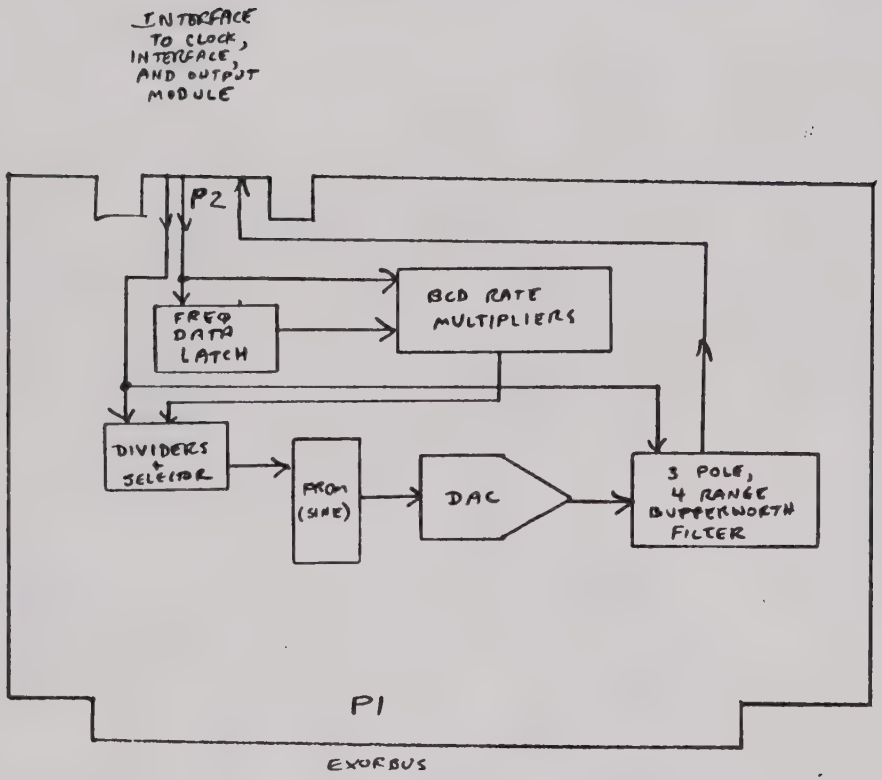


FIGURE 4-5 TUNE SYNTHESIZER MODULE (A3)

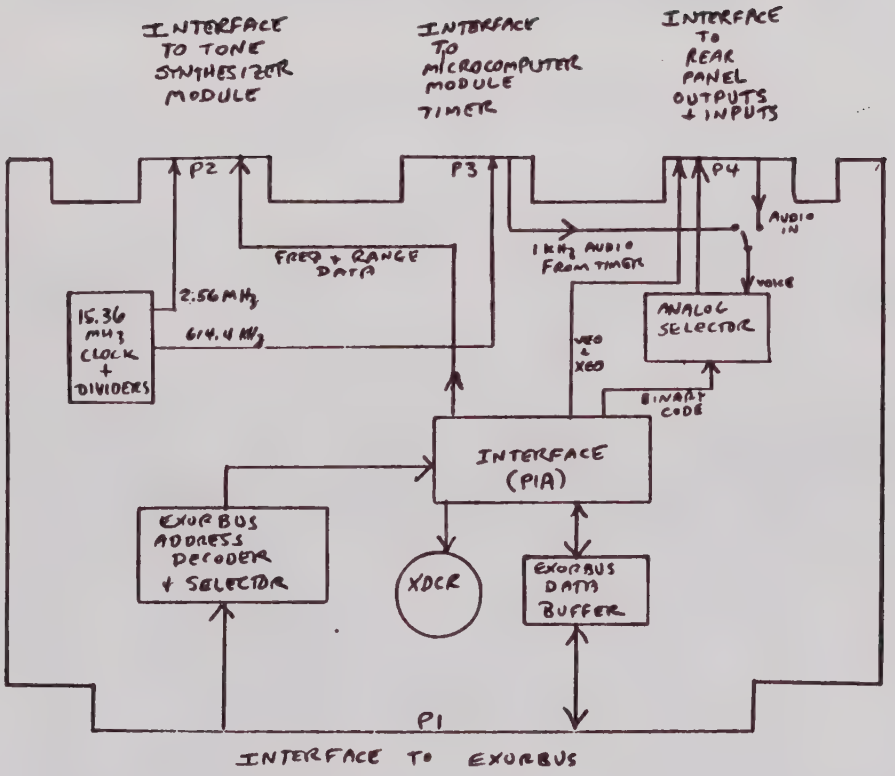


FIGURE 4-5 CLOCK, INTERFACE, AND OUTPUT MODULE (A4)

Chapter 5

Operational Verification

.1 Introduction

This section contains the tests required to verify that the Motorola inary/Tone Encoder is operating properly for incoming inspection, general fter-repair, and general after-construction.

Voltage measurements here need not be accurate for verification of he encoder outputs, only that the outputs amplitudes are near the specified oltages levels to insure that they are present. Calibration of these outputs s refered to section 2 for adjustments.

The encoder lid must be removed and the card cage released to allow wivel to do some of these tests.

.2 Required Test Equipment

A list of test equipment required for the Operational Verification rocedures is given in Table 5-1. Any equipment that satisfies the critical pecifications given in the table may be substituted for the suggested odel.

Table 5-1
Test Equipment Required for Operational Verification

..strument	Critical Specifications	Suggested Model
scilloscope	Vertical: Bandwidth: DC to 100mhz Deflection: 0.1v to 5v/div Horizontal: Sweep: 0.5us to 5ms/div	HP1740A
omputer	IEEE488 Control Capability	HP9816
ine Wave Signal ource	Frequency Range: 10hz to 10khz Amplitude: 4 v peak to peak into 600 ohms	

5.3 Display Check

Power up the encoder. The display should look like Figure 5-1 except ere the X.X is at the upper right of the display which displays the version of the firmware.

Figure 5-1
Title page of encoder menu.

```
MOTOROLA BINARY/TONE ENCODER X.X
COPYRIGHT 1984 BY MOTOROLA, INC.,
     ALL RIGHTS RESERVED.
CODE = [        GSC        ]
                 -
```

5.4 Keyboard and Transducer Test

Press the 16 keys of the front panel keyboard. Each key press should cause a beep to be heard from inside the encoder. Press the STOP key. A beep should be heard. Press the SCROLL [FIELD] key. The CODE field of the display in brackets [] should display POCSAG. Press the SCROLL [FIELD] key again. The field should then display 2 TONE. Press ENTER. The first page of the 2 TONE menu should be displayed as shown in Figure 5-2. Press the down

Figure 5-2
First page of 2 Tone code menu.

```
2 TONE CODE:
 TONE SEQUENCE = [A-B]
 TONE A FREQUENCY = (123.4) HZ
 TONE B FREQUENCY = (234.5) HZ
```

CURSOR key. The display underline should appear under the 1 of the TONE A FREQUENCY field. Press the key marked 0 on the upper left of the keyboard. A 0 should appear and the cursor should move to the right under the 2. Press the right CURSOR key. The cursor underline should move under the 3 in the TONE A FREQUENCY field. Press the upper right KEY QUADrant key then press the S key (3 key). A beep should be heard. Press the lower left KEY QUADrant key then the # key (3 key). A beep should be heard. Press the lower right KEY QUADrant key then the C key (3 key). A beep should be heard. Press the upper left KEY QUADrant key then the 4 key. The 4 should appear where the cursor underline was and the cursor underline should move under the decimal point. Press the left CURSOR key. The cursor underline should move under the 4 before the decimal point. Press the up CURSOR key. The cursor underline should move to the A-B of the TONE SEQUENCE field. Now press the XMIT key. TRANSMISSION IN PROGRESS should be displayed and if the encoder is running properly, the 2 TONE CODE menu should reappear after about 3 seconds and a beep should be heard.

All the keys of the keyboard have been tested except the RESET key. Also, display and transducer have been tested.

.5 Reset Check

Press the RESET key. The display should look like Figure 5-1 again.

.6 Binary Transmission Verification

Connect an oscilloscope to the TRANSMISSION OUTput on the rear panel of he encoder. Set the VOLTS/DIV to 0.5. The signal should be near 0 volts. f not, refer to the section 2 for adjustments.

After the RESET has been pressed, press the SCROLL [FIELD] key 4 times ntil BINARY CALIBRATION is displayed in the CODE field. Press XMIT for the inary calibration transmission to the TRANSMISSION OUTput on the rear panel.

The signal should be a square wave with its maximum voltage level near 1 olts and its minimum voltage level near -1 volts. The repetition rate should e 125 pulses per second. If the amplitudes of the signal are not correct, efer to section 2 on adjustments.

To stop the transmission, press RESET or let it time out.

.7 Tone Transmission Verification

Connect an oscilloscope to the TRANSMISSION OUTput on the rear panel of he encoder. Set the VOLTS/DIV to 0.5. The signal should be near 0 volts. f not, refer to the section 6 for adjustments.

After the RESET has been pressed, press the SCROLL [FIELD] key 5 times ntil TONE CALIBRATION is displayed in the CODE field. Press XMIT for the one calibration transmission to the TRANSMISSION OUTput on the rear panel.

The signal should be a sinusoidal wave with its maximum voltage level at .J volts and its minimum voltage level at -1.0 volts. The frequency should e 1000 hz with some step-like perturbations in the signal. If the amplitudes f the signal are not correct refer to section 6 for adjustments.

To stop the transmission, press RESET or let it time out.

.8 Transmission Gate Output Verification

Connect an oscilloscope to the TRANSMISSION GATE OUTput on the rear panel f the encoder. Set the VOLTS/DIV to 2. The signal should be below 0.5 volts.

After the RESET has been pressed, press the ENTER key. The GSC CODE menu hould appear on the display. Press XMIT and observe a level of over 3.4 volts n the TRANSMISSION GATE OUTput for the duration of the transmission, about 3 econds.

.9 Voice Gate Output Verification

Connect an oscilloscope to the VOICE GATE OUTput on the rear panel of the ncoder. Set the VOLTS/DIV to 2. The signal should be below 0.5 volts.

After the RESET has been pressed, press the ENTER key. The GSC CODE menu hould appear on the display. Press SCROLL [FIELD] once. A 2 should appear in he TRANSMIT FUNCTION field, this represents a voice transmission as program- ed. Press XMIT and observe a level of over 3.4 volts on the VOICE GATE OUTput er about 2 seconds and lasting for about 4 seconds before the end of the nsmission.

5.10 Voice Transmission Verification

The encoder has voice capability from either the external AUDIO INput on the rear panel or an internal 1 kpps timer. The following 2 items test the voice:

5.10.1 Audio Input Verification

With the encoder lid open, swivel the card cage away from the cabinet base such that the A4 board can be viewed from the edge. Flip SW1 to the right as the board is viewed from its top edge. This selects the AUDIO INput as the voice input.

Connect an oscilloscope to the TRANSMISSION OUTput on the rear panel of the encoder. Set the VOLTS/DIV to 0.5. The signal should be near 0 volts. If not, refer to the section 6 for adjustments.

Apply an audio signal of 4 volts peak to peak to the AUDIO INput on the rear panel of the encoder with a sine signal source (audio generator).

After the RESET has been pressed, press the ENTER key. The GSC CODE menu should appear on the display. Press SCROLL [FIELD] once. A 2 should appear in the TRANSMIT FUNCTION field, this represents a voice transmission as programmed. Press XMIT and observe a bit stream for about 2 seconds, then the AUDIO INput signal, lasting for about 4 seconds before the end of the transmission with an amplitude slightly greater than the bit stream amplitude, should be present.

5.10.2 1Khz Pulse Train Verification

With the encoder lid open and the card cage swiveled away from the cabinet such that the A4 board can be viewed from the edge, flip SW1 to the left as the board is viewed from its top edge. This selects the 1 kpps timer as the voice input.

Connect an oscilloscope to the TRANSMISSION OUTput on the rear panel of the encoder. Set the VOLTS/DIV to 0.5. The signal should be near 0 volts. If not, refer to the section 6 for adjustments.

After the RESET has been pressed, press the ENTER key. The GSC CODE menu should appear on the display. Press SCROLL [FIELD] once. A 2 should appear in the TRANSMIT FUNCTION field, this represents a voice transmission as programmed. Press XMIT and observe a bit stream for about 2 seconds; then a 1 kpps filtered square wave, lasting for about 4 seconds before the end of the transmission with an amplitude slightly greater than the bit stream amplitude, should be present.

5.11 RS232C Interface Test

Connect a video terminal with an RS232C interface cable to the encoder RS232C interface on the encoder rear panel. If the terminal is an EXORterm, flip the FLAG2 switch down; if a terminal using $1E as the home character (Televideo 910), flip the FLAG2 switch up.

The interface operates with the RS232C of the encoder set for 9600 baud, 8 bit data, 1 stop bit, no parity, and no handshaking (CTS is high).

Power-up the terminal and the encoder. The display on the terminal should appear the same as the display on the encoder front panel except that many of the characters will be lower case.

Press the SCROLL [FIELD] key 6 times so that REMOTE OPERATION appears n the CODE field. Press ENTER or XMIT. REMOTE COMMUNICATION OPERATION should near on the encoder display. A "." should appear at the terminal's sor. Type any alphanumeric character on the terminal. The character should ppear on the terminal display.

.12 IEEE488 Interface Test

Connect a host computer with an IEEE488 interface, such as an HP9816 sing a standard IEEE488 cable, to the encoder IEEE488 interface on the rear anel. Set the IEEE488 address switches on the rear panel on the encoder to inary 01010 (decimal 10).

Power-up the host computer and the encoder. Program the host computer o communicate with the encoder. An example program using the HP9816 to ownload 3 queue blocks to the encoder then read them back is shown in igure 5-3. The HPIB interface on the computer is set for 7.

Figure 5-3
Example HPL Program to Test IEEE488 Interface

```
0: dim A$[21]
1: wtb710,13                                ;% remote the encoder
2: fmt1,c,b,z
3: wrt710.1,"0,000100",13                   ;% load 3 blocks
4: wrt710.1,"1,@GN",13
5: wrt710.1,"2,W01000H2",13
6: wrt710.1,"L0,2",13                       ;% command to list 3 blocks
7: for I=1to3;red710,A$;prtA$;nextI         ;% loop to readback
8: prt"";end
```

The encoder display at power-up should be the display shown in Figure -1. When the host computer sends the first character, the encoder display hould change to REMOTE COMMUNICATION OPERATION.

Chapter 6

Adjustments

.1 Introduction

This section contains the procedures necessary to properly adjust the otorola Binary/Tone Encoder for calibrated operation. The encoder lid must e removed and the card cage released to swivel.

.2 Required Test Equipment

A list of test equipment required for the calibration adjustment rocedure is given in Table 6-1. Any equipment that satisfies the critical pecifications given in the table may be substituted for the suggested odel.

Table 6-1
Test Equipment Required for Calibration Adjustment

nstrument	Critical Specifications	Suggested Model
scilloscope	Vertical: Bandwidth: DC to 100Mhz Deflection: 0.1v to 5v/div Horizontal: Sweep: 0.5us to 5ms/div	HP1740A
recision Frequency Counter	Time Base Accuracy: 1e-10 per day Frequency Range: 1Mhz to 100Mhz	HP5335A with 010 OPTION

.3 Ground Level

Reset the encoder.

~~Connect the oscilloscope to test point 8 of A4. Adjust the voltage to .0 volts +/- 0.01 volts using R8.~~

Connect the oscilloscope to the TRANSMISSION OUTput of the encoder with tee into 600 ohms. Adjust the voltage to 0.0 volts +/- 0.01 volts with the FFSET pot on the rear panel of the encoder. DO NOT ADJUST REAR PANEL OFFSET ONCE IT HAS BEEN SET AT GROUND LEVEL IN THE QUIESCENT STATE

.4 Binary Levels

Set the encoder CODE field of the title menu to BINARY CALIBRATION sing the SCROLL [FIELD] key.

Connect the oscilloscope to test point 10 of A4.

Press XMIT.

Adjust R2 (offset) and R1 (gain) of the square wave to where the maximum oltage level is at +1.0 volt +/-0.05 volt and the minimum voltage level is at 1.0 volt +/-0.05 volt. AND THE BINARY WAVEFORM IS CENTERED AT GROUND LEVEL DC OFFSET.

Connect the oscilloscope to the TRANSMISSION OUTput on the rear panel of the encoder with a tee into 600 ohms.

Press XMIT.

Adjust the [redacted] GAIN pots ONLY on the rear panel of the encoder to where the maximum voltage level is at +1.0 volt +/- 0.05 volts and the minimum voltage level is at -1.0 volt +/-0.05 volt. IF BINARY DC OFFSET IS NOT AT GROUND LEVEL, THEN ADJUST DC OFFSET ON A4 BOARD ONLY.

6.5 Tone Levels

Set the encoder CODE field of the title menu to TONE CALIBRATION using the SCROLL [FIELD] key.

Connect the oscilloscope to test point 3 of A3.

Press XMIT.

Adjust R21 to increase the maximum voltage of the step sine wave to as near 10 volts as possible by clockwise pot rotation without noticable distortion. THIS IS DONE BY PEAKING STEP SINE WAVE SIGNAL IN CLOSE

Connect the oscilloscope to test point 7 of A3. PROXIMITY TO [redacted] 10V AT TP

Press XMIT.

Adjust R19 (offset) and R20 (gain) of the sine wave to where the maximum voltage level is at +1.0 volt +/-0.05 volt and the minimum voltage level is at -1.0 volt +/-0.05 volt. AND WAVEFORM IS CENTERED ABOUT 0V. DC OFFSET.

Connect the oscilloscope to the TRANSMISSION OUTput on the rear panel of the encoder with a tee into 600 ohms.

Press XMIT.

Adjust the "[redacted] GAIN" pots on the A3 BOARD ONLY [redacted] of the encoder to where the maximum voltage level is at +1.0 volt +/- 0.05 volts and the minimum voltage level is at -1.0 volt +/-0.05 volt. AND THE WAVEFORM IS CENTERED AT 0V. DC OFFSET.

6.6 Clock rate (optional)

Connect the precision frequency counter to test point 1 of A4.

Measure the frequency to 15.36Mhz +/- 153Hz (10ppm).

Adjust the clock trimmer cap if required with a .05" square trimmer tool. The trimmer cap is located on the side of U2 of A4. If the frequency of the clock does not adjust within 10ppm tolerance, certain codes of the encoder can still be run. GSC requires 50ppm, POCSAG requires 15ppm, NTT requires 10ppm, and all tones require 50ppm. Exchange the clock (U2) if the desired clock frequency tolerance is not usable.

IF LEVEL AND OFFSET ADJUSTMENTS HAVE BEEN DONE PROPERLY, THEN BOTH BINARY AND SINE WAVEFORM CALIBRATED OUTPUTS WILL BOTH BE CENTERED AT GROUND LEVEL AND WILL HAVE +1V TO -1V PEAK-TO-PEAK AMPLITUDE

Chapter 7

7 Performance Tests

7.1 Introduction

This section contains the tests required to characterize the performance of the Motorola Binary/Tone Encoder. The encoder lid need not be removed to do these tests unless calibration is required, then refer to section 6.

7.2 Required Test Equipment

A list of test equipment required to characterize the performance of the encoder is given in Table 7-1. Any equipment that satisfies the critical specifications given in the table may be substituted for the suggested model.

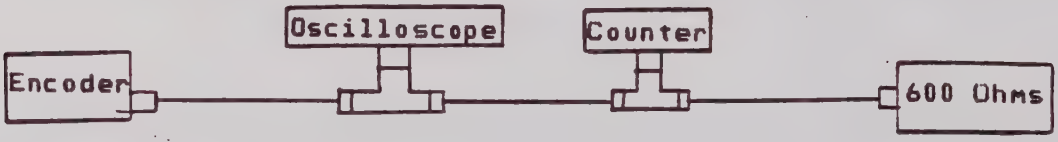
Table 7-1
Test Equipment Required for Performance Tests

Instrument	Critical Specifications	Suggested Model
Oscilloscope	Vertical: Bandwidth: DC to 100Mhz Deflection: 0.1v to 5v/div Horizontal: Sweep: 0.5us to 5ms/div	HP1740A
Electronic Counter	Frequency Measurement to 10Khz Accuracy: +/- 1 count Resolution: 5 digits	HP5328A
Distortion Analyzer	Fundamental Frequency Range 10hz to 10khz Harmonic Measurement Accuracy: +/- 3% Fundamental Frequency Rejection: >80db	HP334A
Optional:		
High Frequency Spectrum Analyzer	Frequency Range: 100 khz to 1 Ghz Amplitude Accuracy: +/- 1db Noise: >70db below reference	HP141T HP8552B HP8554B
Low Frequency Spectrum Analyzer	Frequency Range: 20 hz to 300 Khz Amplitude Range: 1mv to 5v Noise: >80db below reference or -140dbv	HP141T HP8552B HP8554B
Inch Loop Antenna	Critical Dimensional Tolerances	HP08640-60501

7.3 Binary Signal Tests

Connect the oscilloscope, the electronic counter, and a 600 ohm load the TRANSMISSION OUTput of the encoder with two BNC cables and 2 BNC tee connectors as shown in Figure 7-1. This test set up is used for both the binary and tone code signal tests.

Figure 7-1
Code Signal Test Set Up



7.3.1 Rise and Fall Time Tests

Reset the encoder then select BINARY CALIBRATION with the SCROLL [FIELD] key. Press the XMIT key to transmit the square wave.

Set the oscilloscope to 0.5v/div amplitude and 0.5us/div sweep speed.

Trigger the oscilloscope on positive edges and observe the rise time. The rise time should be between 10us and 20us from the 10% to the 90% amplitude points on the waveform.

Trigger the oscilloscope on negative edges and observe the fall time. The fall time should be between 10us and 20us from the 90% to the 10% amplitude points on the waveform.

3.2 Frequency Tests

With the CODE field still set at BINARY CALIBRATION, press the XMIT key to transmit the square wave again.

Measure the frequency to be between 124.99875hz to 125.00125hz or measure the period to be between 7.99992ms to 8.00008ms. Refer to section 6.6 if this frequency is incorrect.

7.4 Tone Signal Tests

Set up this test using the RS232C interface with a video terminal for control of the encoder.

Reset the encoder, then by using the SCROLL [FIELD] key on the encoder keyboard or the space bar on the terminal, set the field to REMOTE OPERATION. Input the following character strings using carriage return without line feeds:

```
0,000100
1,@T
2,F1000R0D10000
3,F9999R0D10000
4,F1000R1D10000
5,F9999R1D10000
6,F1000R2D10000
7,F9999R2D10000
8,F1000R3D10000
9,F9999R3D10000
```

L Ø,9
X0,9

These strings fill the first 10 encoder queue buffer blocks with 8 nes in sequence lasting 10 seconds each. The 8 frequencies are 1000hz, 99hz, 500.0hz, 4999.5hz, 100.0hz, 999.9hz, 10.00hz, and 99.99hz.

To list these strings back to the video display, input "L0,9".

To transmit this sequence and measure frequency, amplitude, and stortion of each of the 8 tones, input "X0,9".

4.1 Frequency Tests

Connect the electronic counter to the TRANSMISSION OUTput of the coder with a tee into 600 ohms or use set up as in Figure 7-1.

Measure each of the 8 frequencies of section 7.4 as they are ansmitted. The frequencies are within 50ppm tolerance as per Table 7-2.

Table 7-2
Measured Frequency Limits

equency	Minimum Measured Frequency	Maximum Measured Frequency
1000hz	999.95hz	1000.1hz
9999hz	9998.5hz	9999.5hz
500hz	499.97hz	500.03hz
99.5hz	4999.2hz	4999.8hz
00.0hz	99.995hz	100.01hz
9.9hz	999.85hz	999.95hz
u.00hz	9.9995hz	10.001hz
9.99hz	99.985hz	99.995hz

4.2 Amplitude Tests

Connect the oscilloscope to the TRANSMISSION OUTput of the encoder with tee into 600 ohms or use set up as in Figure 7-1.

Measure each of the 8 frequency minimum and maximum voltage amplitudes section 7.4 as they are transmitted. The maximum voltage point should be .0 volts +/- 0.05 volts and the minimum voltage point should be -1.0 volts - 0.05 volts.

4.3 Harmonic Distortion Tests

Connect the distortion analyzer to the TRANSMISSION OUTput on the ar panel of the encoder. Make sure the load is 600 ohms.

Measure each of the 8 frequency distortions of section 7.4 to be less an 3%. The lower frequencies of an "R" range will have distortions near while the higher frequencies of an "R" range will have distortions less an 1% if the Butterworth filters are operating properly.

This test can also be done using the low frequency spectrum analyzer determine the harmonic frequencies and their amplitudes.

Chapter 8

1 Maintenance

1.1 Routine Maintenance

A regular program for maintenance and inspection every five to six
nths is recommended for this unit. As part of this program, the unit
hould be checked as follows:

. Disconnect ac power and remove the top cover.

. Make a thorough visual inspection of all wiring and cables. Check
or frayed, loose, or burned wires.

. Inspect components for their physical integrity. Look for burned
r cracked components, loose solder connections, leakage of insulation
ompounds, and general physical damage. Ensure that all plug-in components,
uch as integrated circuits, transistors and connectors, are firmly seated
n their mating sockets. Never unnecessarily remove and replace a plug-in
omponent. Also, ensure that all address switches are in their proper
ositions.

. Inspect circuit boards and components for an excessive amount of
ust deposited on them. Use a soft brush and low pressure air stream to
emove the dust.

CAUTION

Do not clean the circuit boards or small components with a stiff brush or solvents, since damage may result. A high powered vacuum cleaner or air stream should not be used on small components. Solvents may damage the pc switches, potentiometers and transducer internally.

. Clean the external surfaces of the unit with a soft, damp cloth to
emove dirt, fingerprints, and other foreign materials.

. Replace the top cover and reconnect power. Check performance. If
erformance does not equal or exceed the specifications, corrective
aintenance may be required.

CAUTION

The unit contains pc boards with CMOS integrated circuits which require special handling techniques to prevent irrepairable damage from static charges. Refer to the SAFE HANDLING OF CMOS INTEGRATED CIRCUIT DEVICES instructions in the appendix.

11.2.1 POWER SUPPLY MODULE Verification

Check power supply voltage levels. The following voltages should be measured at the corresponding test points of the card cage board with repect to the ground test point 1:

voltage	test point	
+4.90 to +5.40	2	(Can be adjusted)
+11.50 to +12.50	3	(fixed)
-11.50 to -12.50	4	(fixed)

11.2.2 TONE SYNTHESIZER MODULE Calibration

Refer to section 6 for calibration of this module.

11.2.3 CLOCK, INTERFACE, AND OUTPUT MODULE Calibration

Refer to section 6 for calibration of this module.

11.2.4 TRANSMISSION OUTput Calibration

Refer to section 6 for calibration of this module.

11.3 Corrective Maintenance

A qualified service technician is required to service this equipment.

APPENDIX

M E M O R A N D U M

To: Jim Ehle
Pete Kahn
Art Lafond
Hector Li
Audley Patterson
Bob Schneider
Dave Winfree

From: Al Weidler
Date: Mar 7, 1985

Subject: Recent Encoder Upgrade which affects test station software.

VERSION 3.3

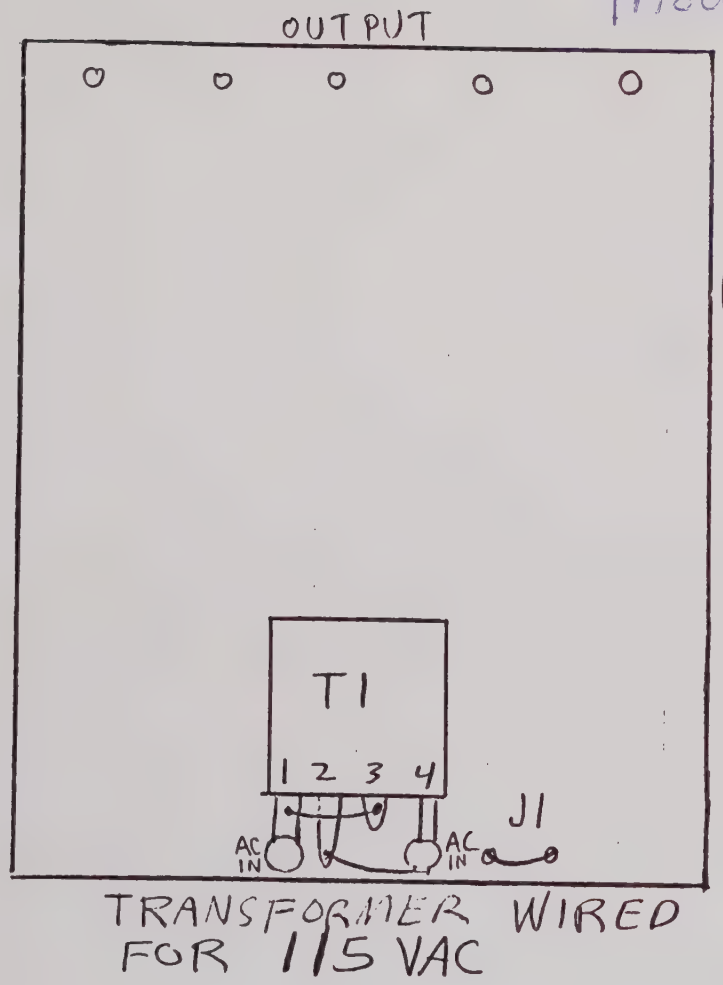
The Motorola Binary/Tone Encoder has been upgraded to include the standard <CR/LF> eot to send information and commands to it on either the RS232C or the GPIB interface.

The FLAG1 switch on the rear panel must be in the 'up' position to use this eot sequence. If the switch is in the 'down' position, <LF> characters cannot be used after <CR>. The FLAG1 switch in the 'down' position will enable all present test system software to be used as is.

The FLAG1 switch is read on encoder power-up or reset.

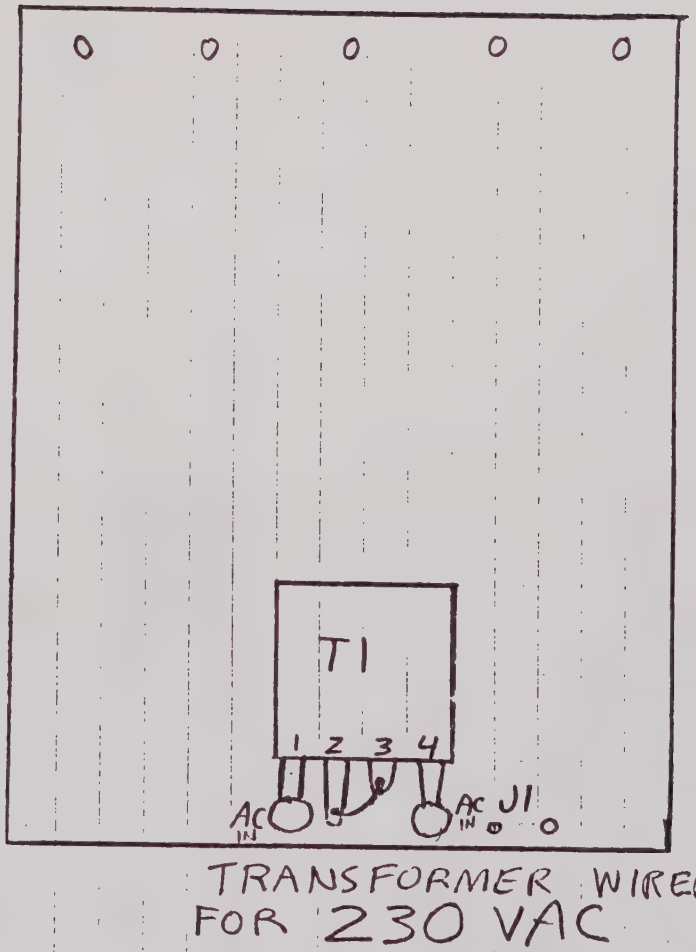
Regards,
Al Weidler

Model 3050-1



TRANSFORMER WIRED FOR 115 VAC

UNIVERSAL ENCODER POWER SUPPLY



TRANSFORMER WIRED FOR 230 VAC

TO CHANGE POWER SUPPLY TO 230VAC REMOVE JUMPERS 1-3, 2-4, AND J1. INSERT JUMPER 2-3 AS SHOWN IN RIGHT FIGURE.

MOTOROLA INC.

Paging Division
Inter–Office Correspondence

Date: Nov –12–91

To: Bill Smith

From: Suhail Jalloul

cc: Ken Wasko
Fernando Torre
Rafael Rodriguez

Subject: Converting a 1200BPS encoder to 2400BPS.

To convert a 1200 bit encoder to 2400 bit the following devices should be replaced

Board	IC	Device	From	To
Micro Computer	U5	uP	MC6809P	MC68B09
Micro Computer	U15	ACIA	MC6850	MC68B50
Micro Computer	U16	TIMER	MC6840	MC68B40
Micro Computer	U17	EEPR0M	27128	27C128
Micro Computer	U18	EEPR0M	27128	27C128
Micro Computer	NA	XTAL	4MHZ	8MHZ

Note: Use 9.01 software revision.

GPIB DISP HEY	U1	PIA	MC6821	MC68B21
GPIB DISP HEY	U2	PIA	MC6821	MC68B21
GPIB DISP HEY	U9	GPIB INT	MC68488	MC68B488
CLOCK & INT	U3	PIA	MC6821	MC68B21

Flag 1 operation was changed to support the **Encode** program used on the IBM using the RS232 port.

Flag 1	
0	Televideo terminal
1	IBM computer running the **Encode** program.

TO : JAY
FROM : PETE KAHN
DATE : 2/11/85

SUBJECT : UNIVERSAL ENCODER A6 BOARD CONFUSION

There are 2 revisions of the A6 PC board presently circulating throughout the factory. The easiest way to distinguish between them is by presence of the C6 (30 pf CAP between pins 1 and 5 of U1). The newer revision has the capacitor and the older revision does not.

The old revision (without C6) needs a few minor corrections to allow the GPIB interface of the unit to function properly. These changes are as follows :

1. Cut land between RP1 pin 1 and DIP switches.

2. Jumper TP3 and TP4 together.

Please take the time to update any of the old revision boards which you happen to come accross while repairing and refurbishing [redacted] the Universal Encoders.

Regards,

Peter A. Kahn

MP MASTER
MA29565